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Tables of Spectral-Line Intensities

Arranged by Wavelengths

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Tables of Spectral-Line Intensities

Part II

Arranged by Wavelengths

The intensity, character, wavelength, and spectrum of 39,000 lines between 2000 A and 9000 A observed in copper arcs containing 0.1 atomic percent of each of 70 elements.

William F. Meggers, Charles H. Corliss, and Bourdon F. Scribner

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Tables of Spectral-Line Intensities

William F. Meggers, Charles H. Corliss, and Bourdon F. Scribner

The relative intensities, or radiant powers, of 39,000 spectral lines with wavelengths between 2000 and 9000 Angstroms have been determined on a uniform energy scale for seventy chemical elements. This was done by mixing 0.1 atomic percent of each element in powdered copper, pressing the powder-mixture to form solid electrodes which were burned in a 10 ampere, 220 volt direct-current arc, and photographing the spectra with a stigmatic concave grating while a step sector was rotating in front of the slit. The sectored spectrograms facilitated the estimation of intensities of all element lines relative to copper lines which were then calibrated on an energy scale provided by standardized lamps, and all estimated line intensities were finally adjusted to fit this calibration. Comparisons with other intensity measurements in individual spectra indicate that the National Bureau of Standards spectral-line intensities may have average errors of 20 percent, but first of all they provide uniform quantitative values for the seventy chemical elements commonly determined by spectrochemists. These data are presented by element in part I, and all 39,000 observed lines are given in order of wavelength in part II.

1. Introduction

Spectrochemistry was born a century ago when Kirchhoff and Bunsen [1] [1] definitely demonstrated that chemical elements were uniquely identified by spectral radiations, or lines as seen in a spectroscope provided with a slit. This led immediately to the identification of many chemical elements in the sun and to the discovery of several new elements, but no quantitative chemical analyses were made until much later.

In 1874, Lockyer [2] stated that "while the qualitative spectrum analysis depends upon the *positions* of the lines, the quantitative analysis depends not upon their position but upon their *length, brightness, thickness*, and *number* as compared with the number visible in the spectrum of a pure vapor". Thus, position (or wavelength) and brightness (or intensity) are recognized as being the two most important properties of spectral lines; wavelengths identify chemical elements and intensities indicate the concentrations of identified elements in mixtures or chemical compounds.

During the past century there has been spectacular improvement in the accuracy of spectral wavelength determinations; the early ones were limited to 3 or 4 figures, the later use of diffraction gratings and wavelength standards permitted the specification of 5 or 6 figures. Since 1900 the application of interferometers and better gratings has refined many wavelengths to 7 figures, and recently some 8-figure values of wavelength standards have been provided. Unfortunately during this past century very little progress has been made in assigning uniform quantitative intensity values to spectral radiations. The great bulk of spectral observations have been made photographically because photographic emulsions provide detailed, permanent records of spectra not only in the visible but also in the invisible ultraviolet and infrared regions. But even if the light source is reproducible and standardized it is not easy to evaluate the spectral efficiencies of spectrographs and photographic emulsions so the usual procedure has been to make subjective visual estimates of relative intensities of spectral lines on an arbitrary scale based on the relative blackness and/or width of spectral-line images appearing on a developed photographic plate. Consequently, in thousands of individual papers and in numerous comprehensive compilations of spectral data we find only qualitative data on intensities which may have some meaning for adjacent lines in a given spectrum but none at all when comparing widely spaced lines, or lines of different spectra of the same element or of different chemical elements.

In the beginning, most intensity data were reported on an arbitrary scale of 10 steps, weak lines being assigned an intensity of 1, and the strongest line intensity 10. Even as late as 1945 extensive new spectral tables prepared by Gatterer and Junkes [3] displayed estimated intensities on this limited 1 to 10 scale. Since 1910 some spectroscopists have arbitrarily expanded this arbitrarily compressed scale. For example, in the very extensive spectral tables published by Exner and Haschek [4] the estimated intensities range from 1 to 1000. In wavelength tables compiled by Twyman and Smith [5] the maximum intensity is 20, in the compilation of Kayser and Ritschl [6] estimated intensities rise to 4000, and in the well-known M.I.T. Wavelength Tables [7] they soar to 9000. The most recent compilation of Tables of Spectrum Lines by Zaîdel, Prokof'ev, and Raiskiĭ [8] quotes data from the M.I.T. Tables and more modern sources but adds nothing new on spectral line intensities.

[1] Figures in brackets indicate the literature references on page XII.

In or about the year 1925, microdensitometers were developed for the purpose of quantitative measurement of relative intensities among related lines in multiplets to test the sum rules derived from the quantum theory of spectral structure, but no general applications were made. Since then thousands of spectrochemists have applied microdensitometers to quantitative chemical analyses by calibrating intensity ratios of analysis- and internal-standard lines, but such measurements have contributed nothing to the basic data on spectral line intensities. Likewise, with few exceptions, the modern substitution of electronic photodetectors for photographic emulsions has added nothing to our knowledge of true line intensities over long ranges of different spectra of many chemical elements.

How may one hope to obtain, with a reasonable amount of labor, quantitative intensity data on the same scale for thousands of spectral lines representing practically all of the metallic elements? A hint was given in 1874 by Lockyer [2] who observed that "the lines of any constituent of a mechanical mixture disappeared from the spectrum as its percentage was reduced." Acting on this suggestion, Hartley [9], in 1884, began to study the spark spectra of metals in solutions with concentrations of 1 percent, 0.1 percent, 0.01 percent, and 0.001 percent, and proposed a method of quantitative spectrochemical analysis based on the lines that could be detected at each dilution. Similar studies were later made by Pollok and Leonard [10], by de Gramont [11], and by Löwe [12], all showing that with progressive dilution of an element its spectral lines weakened and vanished until only the most sensitive line remained to reveal its presence. In all these works the principle of quantitative spectrochemistry appeared to rest on the *number of lines* detectable rather than on their individual *intensities*. Casual observation must have shown lines of equal strength in spectra of solutions differing 1000 fold in concentration but no one mentioned it. It is difficult to understand why these early studies of residual spectra in quantitatively prepared mixtures or solutions did not suggest a method for obtaining physical intensities, but it is a fact that before our work had begun no one had attempted to express spectral line intensities as directly proportional to the number of radiating atoms or concentration of the element. The present monograph reports such an attempt [13].

Our method of deriving line intensities from arc spectra of elements diluted in copper was recently adopted by Allen [14, 15] to obtain oscillator strengths of some radiations from 3200 to 5400 A representing nine elements.

At various times since 1932 we have photographed the arc spectra of 70 chemical elements diluted in silver or in copper, and determined the line intensities of the diluted elements relative to selected lines of the matrix. An energy calibration of the latter finally led to physical intensities of 39,000 spectral lines representing 70 elements, all on the same energy scale. These experiments and results are based on the following propositions, regarded as fundamental for the quantitative description of residual spectra of diluted elements excited in ordinary d–c arcs.

1. *The limiting detectability of any line is defined as the atomic concentration that ensures positive detection of the line.* This limit is determined mainly by unavoidable background on a fully exposed spectrogram. The spectrum of an arc burning in air consists of discrete lines due to atoms, and of more or less extensive band systems from transient compounds (usually monoxides), all superposed on a continuous background arising from thermal radiation of incandescent oxides, from transitions in the continuum, and possibly from scattered light. This background sets a limit to the exposure for faint lines that may be given by any actual spectrograph. If this were not true, the exposure could be increased indefinitely to compensate for unlimited reduction in concentration, and detectability would always be infinite. Faint lines are not recorded by underexposure, and they cannot be recognized on a very dense background produced by overexposure. In order to guarantee positive recognition and unambiguous chemical identification a spectral line should be sufficiently well defined to permit accurate wavelength measurement. Experience shows that the minimum photographic density that meets this requirement is of the order of 0.05 above that of the background.

2. *The limiting detectability of any element in an arc depends on the matrix in which the element finds itself.* There is no doubt that in the conventional arc relative volatilities of the chemical elements as well as relative ionization potentials affect the relative strengths of their mixed spectra. In general, the elements with high-vapor pressure and/or low-ionization potential will be favored in spectral excitation, but elements with either high or low volatility may be underestimated if not uniformly present during the exposure, and easily ionized elements may appear less sensitive because of more complete ionization. In this connection it must be noted that large differences in apparent detectability are possible if concentrations are expressed in relative weights instead of numbers of atoms. Thus, 0.01 atomic percent of boron in uranium is equal to $<$ 0.0005 weight percent since the uranium atom is 22 times heavier than the boron atom.

3. *The primary substance (matrix) has no important effect on the relative intensities of lines due to a secondary substance.* It is conceded that the relative intensities of analogous spectra of different elements, and of successive spectra of the same element, may vary with the composition of the samples and/or with the type, or portion, of light source from which radia-

tion is taken, but there is no evidence that the relative intensities of lines in any particular spectrum of a given element are thereby greatly changed. It may be expected, therefore, that the relative intensities of lines observed in one metal arc will remain valid in any other metal arc, provided the arcs are at approximately the same temperature. The absolute intensities and the relative strengths of successive spectra may be altered by excitation conditions. For example, silicon may be more sensitive in carbon than in calcium, and it is well known that when easily ionized alkalies are present in sufficient quantity to influence discharge conditions they reduce the intensity of other spectra, especially those characteristic of ionized atoms.

4. *The order of lines arranged according to decreasing detectability in progressive dilution is the same as the order of decreasing intensity in the spectrum of the pure element.* In other words, emission line intensities in residual arc spectra (barring self-absorption) are proportional to the number of radiating atoms, and relative intensities may therefore be derived from concentrations at which different lines show the same intensity or limiting detectability.

Arc spectra usually exhibit a variety of lines, sharp or narrow ones, diffuse or wide ones (including band heads), strong ones accompanied by photographic spreading of developed images, others wide on account of hyperfine structure, and some partially reversed. All of these types, except the last, appear in residual arc spectra at low concentrations, and it may be questioned if it is possible to place them on a uniform intensity scale. It may be assumed that if total blackening integrated over the width of the line when recorded at a moderate level of density be considered in estimating relative intensities these will be on a uniform scale within the limits of precision in making such estimates on lines of different types.

5. *The order of spectral lines arranged according to decreasing intensity is the same when the intensities are decreased by rotating stepped sectors as when the intensity reduction is produced by successive dilution of the element in a matrix.* This was recognized by Löwe [12] who published an atlas of spark spectra of 44 elements diluted from 1 percent to 0.001 percent and later obtained practically the same results by observing spectra with stepped exposure times [16]. In our experiments the labor of preparing samples of 70 elements in four or more dilutions was greatly reduced by adopting only one dilution (0.1 atomic percent) and then producing further reductions of spectral-line intensities by means of rotating step sectors.

6. *Limiting detectability (as defined in 1.) may be adopted as a physical scale of intensities.* Such intensities may be fixed as follows: In a fully exposed spectrogram of copper containing 0.1 atomic percent of another element any faint but unmistakable line at a given wavelength is assigned unit intensity. Any similar line appearing with unit intensity in a spectrogram when the energy, or concentration, is reduced to $\frac{1}{5}$ is said to be 5 times as strong. Thus, all lines can be assigned relative intensities proportional to their limiting detectabilities by determining either the energy reduction or the concentration reduction at which the stronger lines finally show unit intensity. The atomic percent concentration at which any line will show unit intensity then results from dividing 0.1 by its required energy or concentration reduction. For example, a line of intensity 10 should show plainly at 0.01 atomic percent, while one of intensity 1000 should be easily seen at 0.0001 atomic percent (one in a million). Assuming the ratio concentration/intensity to be constant, the maximum intensity at 100 percent is easily obtained. Thus, a line of intensity 1000 at 0.1 atomic percent will have an intensity value of $1000 \times 100/0.1 = 1{,}000{,}000$ at 100 percent. This indicates a much larger range of spectral intensities than mentioned heretofore, but it is not unrealistic.

2. Experiments

Whereas all earlier experiments on residual spectra of diluted elements involved spark excitation of solutions or fused salts, we decided to employ d–c arc excitation for the following reasons. It has been shown [17] that the first ionization potentials of some seventy metallic elements range from 4 to 11 v and the strongest spectral lines of most of these elements have wavelengths between 2000 and 9000 A, which is the spectral region covered by the present investigations. Furthermore, it is known [18] that the second ionization potential of these elements ranges from 10 to 75 v and that the strongest lines of singly ionized atoms generally have shorter wavelengths than those of neutral atoms, nearly half of them being shorter than 2000 A so that they can be detected only in vacuum spectrographs. Because low-voltage arcs have less ionizing action than high-voltage sparks more atoms will remain in the neutral state and, in general, therefore, arc spectra will exhibit stronger lines and higher sensitivity than spark spectra.

The use of arc spectra in these experiments threatened to introduce errors on account of self-absorption of radiated energy in the arc aura or envelope which consists largely of unexcited neutral vapor atoms. In all spectra of arcs between metal electrodes this is the cause of conspicuous self-reversal of all lines involving the atom's ground state. However, this is a function of vapor density surrounding the arc and if this is reduced to 0.001, self-reversal is usually negligible (see fig. 2). This is our reason for making these experiments with individual elements diluted in copper in the ratio 1 to 1000. When ground-state lines of extra-

ordinary intensity were suspected of some self-absorption, intensity ratios were checked or corrected by examining our earlier spectrograms made with this element diluted to 0.0002 atomic percent in silver.

2.1. Dilution in Silver

Our preliminary experiments, begun in 1932, can be described briefly as follows: solutions of known strength of the elements under investigation were prepared and proper amounts added to pure silver oxide, which was then reduced to metal by heating to make samples containing 8 definite atomic ratios extending from 0.05 to 0.0002 atomic percent of the element added to silver, with a factor of about 2 between 7 successive dilutions. In order to save time and labor, each series of silver samples incorporated 3 to 6 chemical elements, in addition to zinc which supplied internal standards. These samples were burned on pure copper electrodes of a 220 volt d–c arc with 10 amperes. An image of the arc was projected onto the slit of a stigmatic concave grating spectrograph by means of a fused-quartz lens. Each series of excited samples was exposed on successive segments of the slit, and was photographed in four spectral regions ranging from 2000 to 9000 A (see fig. 1). A comparator was employed to measure wavelengths (relative to silver and copper lines) for the identification of the added elements, and relative intensities of all lines belonging to residual spectra of diluted substances were estimated and related to concentration. These results were not satisfactory for the following reasons: The use of silver as a matrix and of copper for arc electrodes precluded the possibility of getting any data for these two elements or for any lines masked by silver and copper lines. Also the inclusion of 3 or more elements in each series of samples resulted in the blending of many lines, especially in complex spectra, so that it was not possible to assign proper intensities in these cases. Furthermore, the method of sample preparation and observing appeared to be unsuited to very volatile elements, or compounds, because no residual spectra could be recorded for them even at concentrations of 0.1 atomic percent.

2.2. Dilution in Copper

In 1941 these preliminary experiments were abandoned in favor of a modified procedure which led to satisfactory results. The chief changes in procedure came with the availability and use of pure metal powders, and a hydraulic press to form solid electrodes of mixed powders. Instead of reducing spectral line intensities to the limit of detectability by successive dilutions of the element in different samples only one dilution (0.1 atomic percent) was prepared and line intensities were reduced by observing through rotating step sectors. The successful procedure may be outlined as follows: An element under investigation was mixed with pure copper powder in the atomic ratio of 1 to 1000. These mixtures were pressed into solid electrodes, and burned in a 220-volt, 10-ampere d–c arc which was imaged entirely on the collimator of a stigmatic grating spectrograph by a lens at the slit. A rotating step sector in front of the slit reduced the spectral intensities to one-fifth in each of four steps (see fig. 2). Spectral intensities of the element added to copper were estimated relative to those of selected copper lines, and this was done separately for each of 70 elements throughout the range of spectrum from 2000 to 9000 A. The true intensities of the selected copper lines above 3300 A that served as internal standards were then measured, by photographic photometry, relative to the known energy distribution in the spectrum of an incandescent tungsten-strip filament at a certain temperature (see fig. 3). Between 2000 and 3300 A a calibrated hydrogen lamp was used to determine the relative intensities of copper lines. Finally the apparent intensities of 39,000 spectral lines of 70 elements, relative to copper, were adjusted to fit the copper calibrations. These experiments thus provide empirically determined lists of the principal lines of all elements actually detectable under average conditions in arc spectra when their concentrations are 0.1 atomic percent, and the individual lines bear intensity numbers approximately proportional to their detectability or their relative energy. That these intensity numbers really represent physical intensities was proved by comparing them with earlier, accurately measured relative intensities of lines in multiplets and with published relative f-values or oscillator strengths of lines in different multiplets extending over a wide range of spectrum.

In order to provide intensity data for spectral lines that are partially or wholly obscured by copper lines a sectored spectrogram of the pure element excited with self-electrodes, or of a metallic compound or salt ex-

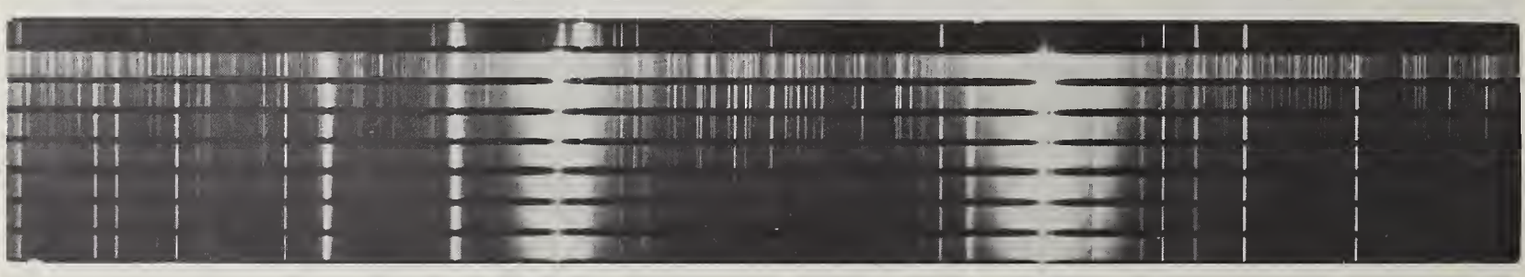

FIGURE 1. *Arc spectra of elements (V, Nb, Ta) diluted progressively in silver, and burned on copper electrodes.*
Spectral range 3880 to 4320 A.

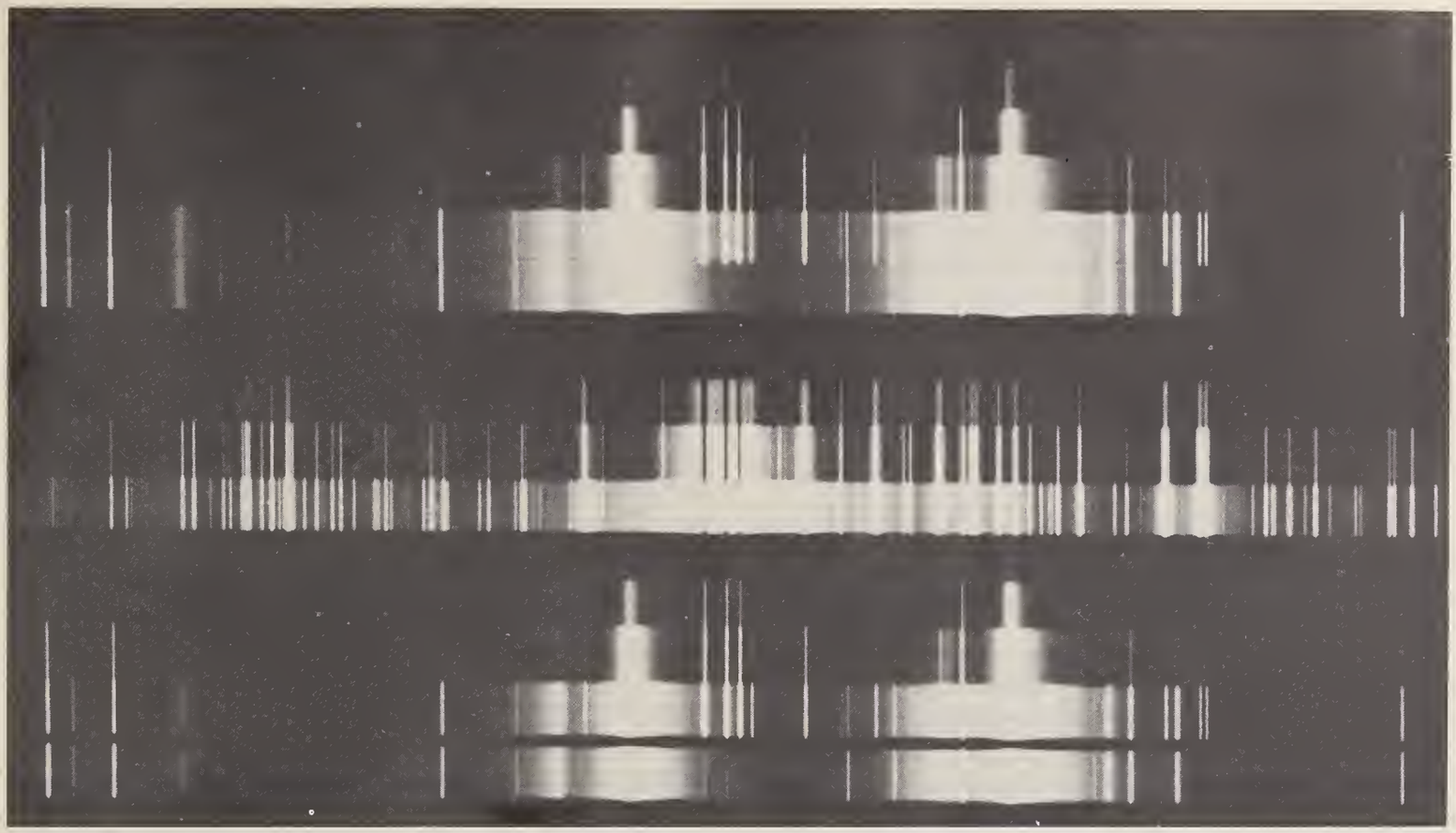

FIGURE 2. *Arc spectra of pure manganese (center), and of copper containing 0.1 percent Mn, (above and below), all through a rotating step sector.* Spectral range 3960 to 4105 A.

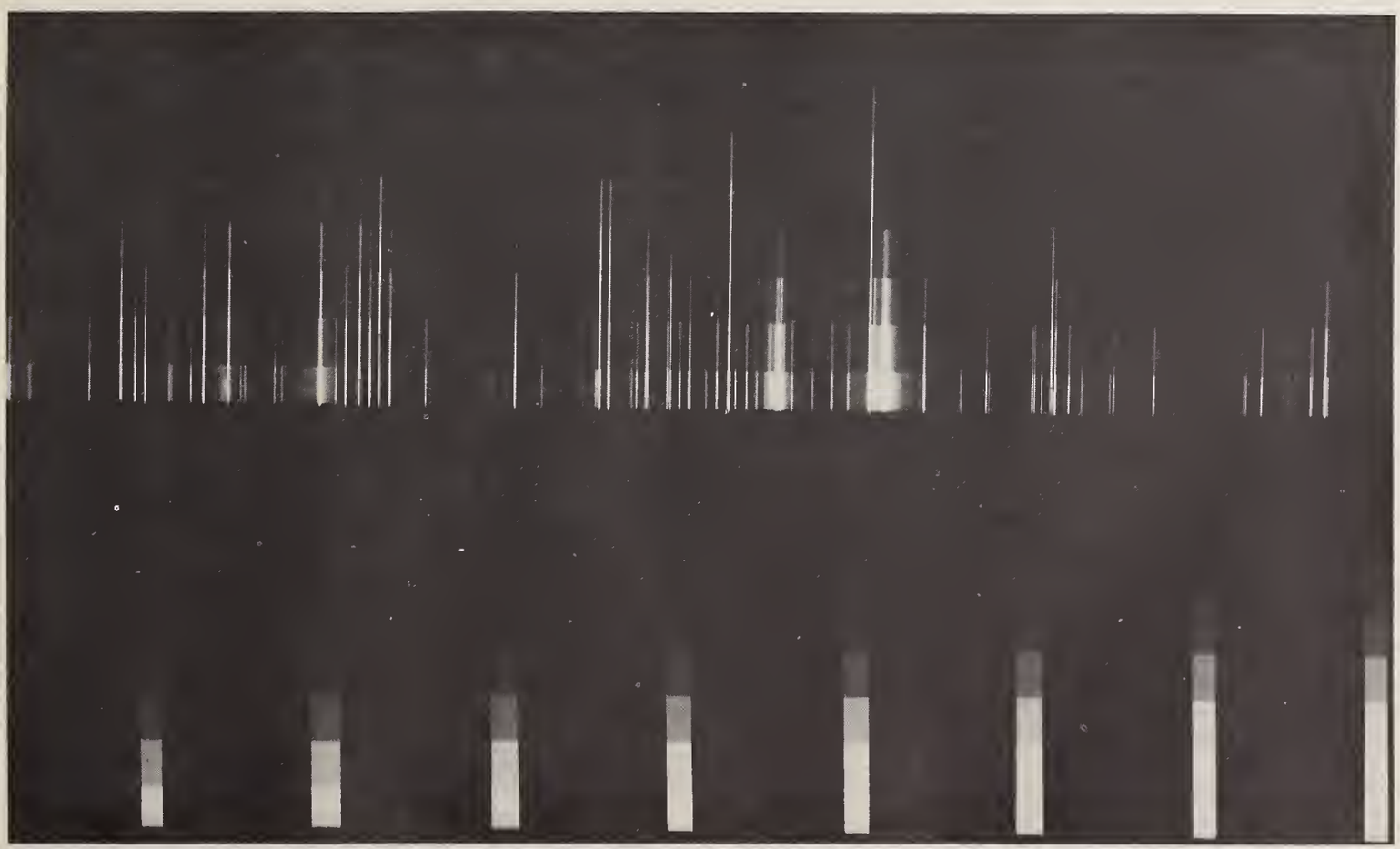

FIGURE 3. *Energy calibration of copper lines.* Above, arc spectrum of copper through rotating step sector. Spectral range 3400 to 3850 A. Below, standard-lamp spectrum at 50 A intervals through same step sector.

cited in a carbon arc, was photographed on every plate so that any lines blended with copper could be interpolated with proper estimates of their relative intensities. Comparison of relative intensities in copper and in carbon matrices also supplied new information on successive spectra, I and II, especially of rare-earth spectra. Similar data for copper itself were obtained by using pressed electrodes of pure silver powder to which 0.1 atomic percent of copper was added, plus the same quantities of gold and zinc to serve as internal standards.

Further details of experimental materials, apparatus, and procedure are given in the following paragraphs.

2.3. Arc Electrodes

For this investigation materials of high purity were acquired, preferably in the form of metal powders, although some elements, not available in pure powdered metal form, were obtained as oxides. In every case the proper amount was added to powdered copper to produce a mixture in which there was one atom of the added element to each 1000 atoms of copper. These mixtures were homogenized by mechanical shaking and then compressed into solid cylindrical pellets in an hydraulic press at 5000 psi. The pellets were ¼ in. in diameter, ¼ in. in length, and weighed about 1.5 gram. Two of a kind were mounted in massive water-cooled clamps in an arc stand and a direct current of 10 amperes passed between them from a 220 v line with ballast resistance. A 3-mm gap was maintained between the electrodes during the exposures which varied in duration from 1 sec to 5 min depending on spectrographic efficiency and sensitivity of photographic plates in different spectral regions.

The arc was imaged on the collimator of a concave-grating spectrograph by means of a quartz lens immediately in front of the slit to obtain uniform illumination along its length and collect light from all parts of the arc. Rotating step sectors were operated immediately in front of the collecting lens, one with 5 to 1 ratio was used for all line-intensity spectrograms, but a 2 to 1 step was used for the energy calibration of copper lines.

2.4. Spectrograph

The dispersing apparatus was a 6-in. grating with 15,000 lines per inch, and 22 ft radius of curvature in a Wadsworth-type mounting to give stigmatic images on photographic plates. All observations were made in the first-order spectrum in which the reciprocal dispersion was 5A/mm, and the practical resolving power about 50,000 with a slit width of 30 μ.

2.5. Photographic Plates

In order to determine, relative to copper, the intensities of all lines of 70 chemical elements diluted 1000 fold it was necessary to make many hundreds of spectrograms, and to employ 4 varieties of photographic plates to cover the wavelength range 2000 to 9000 A. The spectral range 2000 to 3000 A was recorded on Eastman 103–0 Ultraviolet Sensitive plates, 2600 to 4900 A on Eastman 33 plates, 4600 to 6900 A on Eastman II–F plates, and 6600 to 9000 A on Eastman I–N plates. Each plate was developed for 4 min in a rocking tray containing D–19 developer at 70 °F.

The exposure times in each spectral range were chosen by trial to obtain a suitable continuous background in the first step of the rotating step sector. Because of variations in spectral sensitivity of photographic materials and in spectrographic efficiency two exposures of the contaminated-copper arcs were usually made on each plate, with exposure durations in the ratio 2 to 1, and the sectored comparison spectrum of the contaminant was placed between them. Measurements were usually confined to the exposures which showed the optimum background in the first step of the rotating sector.

2.6. Energy Calibration of Copper Lines

In order to determine the factors necessary to convert the estimates of apparent intensities of the lines of 70 elements relative to copper into true relative intensities, it was necessary to determine the true relative intensities of selected reference lines in the spectrum of copper. The energy calibration of copper lines was performed as follows:

A G.E. tungsten ribbon filament lamp (type F339–85, 30 amp, 6v) equipped with a fused quartz window served as the reference standard of spectral energy distribution in the wavelength range 3300 to 9000 A. The brightness temperature of the filament at 6500 A was measured at two values of filament current by Henry Shenker in the National Bureau of Standards Pyrometry Laboratory. The true temperature T of the filament was determined from the brightness temperature by means of the following equation obtained from Wien's law

$$\frac{1}{T} = \frac{1}{T_B} + \frac{\lambda}{C_2} \ln A$$

where $C_2 = 1.438$ cm-deg and A is the product of the emissivity of tungsten (0.427) and the transmittance of the quartz window (0.916) at 6500 A.

TABLE 1. *Temperature of tungsten lamp*

Current	Brightness temperature	True temperature
amp	°*K*	°*K*
38.00	2492	2787
40.00	2567	2881

The energy distribution from blackbodies operated at these temperatures was taken from tables prepared by Stair and Smith [19] in the 2300 to 3500 A range, by Skogland [20] in the 3200 to 7600 A range and by

Lowan and Blanch [21] in the 7200 to 10000 A range. The data from these tables were adjusted to a common basis and multiplied by the emissivity of tungsten and the transmittance of fused quartz at intervals increasing from 50 A in the ultraviolet to 200 A in the infrared. The emissivity of tungsten was taken from a weighted mean curve of published values to which reference is made by Stair and Smith [19]. The transmittance of fused quartz was calculated from data on its index of refraction published by Sosman [22]. The final product, representing the relative energy distribution of the radiation emerging from the quartz window of the lamp, was plotted on a convenient scale to permit interpolation to any wavelength in the range 2300 to 10000 A.

Spectrograms of the pure copper arc and of the tungsten lamp were made under conditions identical with those described above except that for these a 2 to 1 step sector with 8 steps was used for closer calibration (fig. 3). Microphotometer measurements of transmittance were made in each step of the standard-lamp spectrum at intervals of 50 A and a family of calibration curves of transmittance versus log exposure (hereafter referred to as log J) was drawn up for each plate. The exposure of the standard-lamp J_s was read from the calibration curve for each wavelength at a transmittance of 40 percent (where the curve is linear) and then divided by the calculated intensity I_s at that wavelength. I_s is the calculated intensity emitted by the standard-lamp. A standardization curve of log J_s/I_s versus λ was plotted for each plate. Calibration curves of transmittance versus log J were then drawn from measurements on each of the selected copper lines and the log exposure (log J_{Cu}) of each copper line at a transmittance of 40 percent was read from each curve. Log J_s/I_s was then subtracted from the average of numerous values of log J_{Cu} to give log I_{Cu} which is the log of the true relative intensity of the copper line. The values of log I_{Cu} from plates in adjacent wavelength regions were adjusted to a common basis by means of lines common to both plates. The plot of log J_s/I_s versus λ is the relative response function of the plate-spectrograph combination and as such was itself useful in the infrared where the copper spectrum lacks lines suitable for use as an intensity reference.

From 2 to 24 determinations were made on each of 202 lines of Cu I between 2800 and 8100 A with an average of about 9 determinations per line. The values of I_{Cu} obtained by this procedure below 3300 A were systematically low because of the rapid decline in intensity from the standard lamp in the direction of short wavelengths. The intensity from the lamp at 5500 A is about 40 times the intensity at 3300 A and about 300 times the intensity at 2800 A. This fact introduces possible errors from scattered light of the intense visible radiation which tends to raise J_s and consequently depress I_{Cu}.

The spectrum of copper is composed of sharp lines and diffuse lines. Since the microphotometer measurements were made at the peaks of the lines rather than integrated over their widths, the measured intensities of the two groups of lines are on different relative scales, the scale of the diffuse lines being smaller than that of the sharp lines. The reference lines selected for calibration of the estimates of apparent intensity are all sharp lines.

The random error of the photometric procedure, including microphotometer error and irregularities of response of the "N" plates was determined from 92 measurements of apparent relative intensities in spectra of the standard lamp on two plates. The standard deviation of individual measurements from the mean was found to be about 1.5 percent. It is probable, therefore, that the uncertainties in these intensity measurements of the copper lines lie entirely in the systematic errors discussed above and in the random fluctuations of the arc under study.

Since the ribbon filament lamp was too faint in the region from 2000 to 3300 A to serve as a standard, recourse was taken to a Hanovia hydrogen arc lamp. Output from this lamp was compared by R. Stair in the Radiometry Section of the Bureau with a standard tungsten-in-quartz lamp and a standard mercury arc in the region from 2500 to 3800 A; this provided an independent overlapping calibration which carried us down to 2500 A.

The intensity numbers below 2500 A become less accurate as the short wavelength limit is approached. Lacking any reliable energy calibration for shorter waves, the intensity estimates from 2500 to 2000 A were necessarily adjusted by judicious extrapolation, guided by the declining densities of background in the spectrograms, caused by the increasing absorption in the apparatus and in the air at shorter wavelengths.

3. Results

Because these relative intensities of 39,000 lines of 70 elements are based on empirical detectability they will be generally applicable to spectrochemical analysis provided that proper corrections are made on account of different excitation in different matrices. Chemical elements differ in volatility, electron emission, spectral excitation, and spectral background, and consequently their spectral detectability in different mixtures or matrices depends on certain controlling factors. One of the important factors is the atomic ionization potential which ranges from 3.9 v for Cs to 11.3 v for C, and for the investigated 70 elements has an average value of 7.3

v. By mixing these 70 elements with copper, which has an ionization potential of 7.7 v, we obtained excitation conditions very near the average for all. To convert our intensity numbers from copper to any other matrix would require the empirical determination of the proper conversion factor for each element.

It should be pointed out that sensitivity of detection in spectrochemical analysis is commonly given in percent by weight. In order to find the weight percent from the atomic percent given in the tables the following simple relation applies,

$$C_w = \frac{C_a\, A_x}{A_{Cu}}$$

where C_w is the concentration in percent by weight, C_a is the atomic percent (0.1 in this case), A_{Cu} is the atomic weight of copper, and A_x is the atomic weight of the element X.

Although our original intention was to determine the relative strengths of many spectral lines from different chemical elements for purposes of quantitative spectrochemical analysis we believe that the results may also interest theoretical spectroscopists and astrophysicists. For instance, if our intensity numbers, based on concentration detectability and relative energy calibration, actually express relative energies then all may be converted to oscillator strengths, or to relative gf-values, or even to absolute f-values, if the proper conversion factors can be found.

Because of the low concentration of each element in the copper arc from which the spectra were observed, the lines were extraordinarily free from self absorption. This fact suggests that these emission intensities could be converted into relative gf-values, provided that a valid excitation temperature can be assigned to the copper arc.

The temperature of the copper arc can be determined by comparing the observed relative intensities of the lines of an element with the relative gf-values of those lines [23], provided that the arc can be shown to be in local thermodynamic equilibrium for the energy states under consideration. A preliminary investigation of this sort has been carried out by using relative gf-values determined by R. B. King and his coworkers for Ti I [24], Ti II [25], V I [26], Cr I [27], Fe I [28], [29] and Ni I [30] in the region above 3000 A. Figure 4 is a typical example of the correlation of intensities and gf-values indicating the temperature of the copper arc. The comparison shows that our copper arc is sufficiently in equilibrium to yield a temperature which may be useful in calculating approximate gf-values of some utility from our intensity numbers. A preliminary value of 5000 °K ±300 °K has been obtained as the average temperature of the 10 amp, 220 v, copper arc.

Because our intensity data represent single (sometimes two) personal subjective estimates of photographic densities in sectored spectrograms there is no possibility of deriving statistically any probable errors or standard deviations for individual values. However, an estimate of the accuracy or reliability of our data may be obtained by comparing them with quantitative results published by other investigators. For example, figure 4 shows the ratios of our intensities to the relative f-values (or intensities) reported by King and King [24] who measured the total absorptions of Ti I lines in furnace absorption spectra; they stated [28] that "The average deviations of the individual intensity measures from the mean values vary from 4 to 15 percent for different lines" measured between 4 and 16 times on different plates. Each little circle plotted in figure 4 represents a Ti I multiplet of 1 to 12 lines. The average of 59 deviations from the mean of all is 25 percent.

A second indication of the reliability of our intensities is obtained by comparing our values with the relative intensities of lines in multiplets of five elements (Cr, Fe, Mn, Ti, V) measured with photographic densitometry by Frerichs [31] to test the sum rules. Such a comparison in 21 different multiplets indicates deviations ranging from 5 to 22 percent, with an overall average of 14 percent.

A third estimate of the errors in our data results from their comparison with photoelectric intensity measurements in the iron arc by Crosswhite [32], who claims an accuracy of the order of 1 percent. The average difference between intensities of 330 iron lines (3175 to 5658 A) common to these two sets of observations is ±27 percent, but some of this difference may be due to temperature if this is not the same in both arcs.

Other comparisons could be made but the above three are different and typical; they suggest that the average

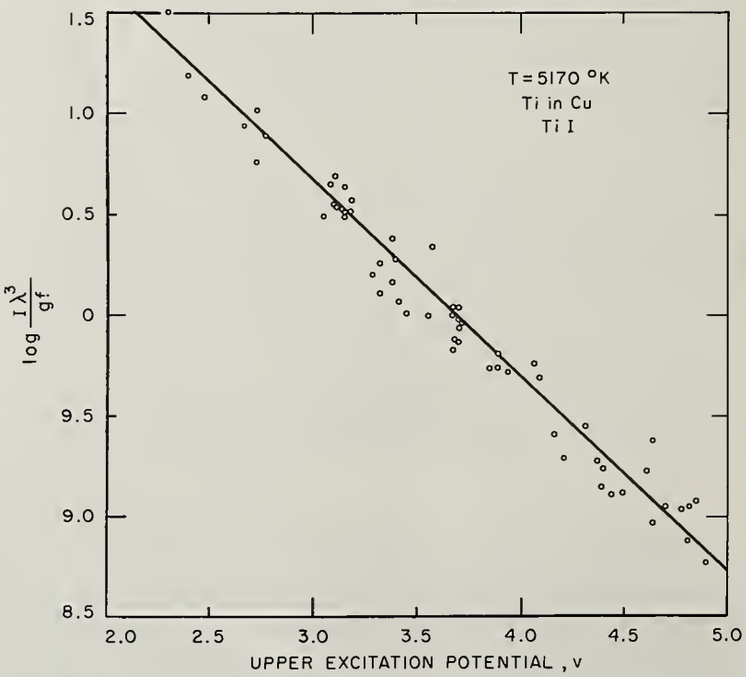

FIGURE 4. *Plot of log intensity* λ^3 *over* gf *versus upper excitation potential of* Ti I *lines.* The temperature of the arc is derived from the slope of the line which best fits the points.

error of our spectral-line intensities within a spectrum of each element is probably between 15 and 25 percent. The uniformity of the intensity scale between the spectra of the various elements is more difficult to assess. Considerable care was taken to obtain spectrograms under comparable conditions for all of the elements; however, differences in volatilities of the elements or their oxides, and differences in ease of excitation may possibly result in shifts of intensity scales between elements. An inspection of the intensities of the strongest lines of the elements indicates that the values are generally in the same order as sensitivity of detection of the elements where these are known. Although no high precision was expected in our mass-production of intensities it is emphasized that reasonably uniform, quantitative values are now available for 39,000 lines emitted by 70 chemical elements.

The tables of spectral-line intensities resulting from this investigation are presented in two parts. In part I the data are arranged by element in alphabetical order of chemical name. The heading of each table by element states the atomic symbol, atomic number, atomic weight, ratio of atomic weight to that of copper, the electron configuration and term symbol of the normal state of each spectrum and the corresponding ionization potential expressed in kaysers (cm^{-1}). Following the heading is a selected list of references. Under *Wavelengths* are listed all of the sources from which the wavelengths used in the table were compiled. Under *Classification* or *Spectrum Assignments* are listed the sources from which the assignment of spectrum and energy levels were obtained. A few spectra showed bands of metallic oxides. References to data about these bands are given under *Molecular Spectra.* In addition a few selected references to published experimental intensity measurements are given under *Intensities.*

Following the references there is abstracted from the main table a list of the strong lines arranged in order of decreasing intensity and giving, in addition to the data found in the main table, the electron configurations and spectral term designations of the energy levels that produce each line. These lists of the strong lines generally contain 2 percent or more of the lines in the main table.

Electron configurations and spectral term designations of quantum numbers are of unusual interest in the production of the strongest spectral lines, or *raies ultimes.* According to well-known rules governing the relative intensities of lines in multiplets, the strongest line arises from transitions between levels having the largest J and L values when $\triangle J = \triangle L = 1$. A rule relating to *raies ultimes* was expressed [33] a quarter of a century ago as follows: "A *raie ultime* in any spectrum originates with a simple interchange of a single electron between s and p states, usually preferring configurations in which only one electron occurs in such states". The above simple rules for the strongest lines appear to be valid for all spectra.

Then comes the main table, listing in order of wavelength, for every line of an element which appears on our plates, the intensity, character, wavelength, spectrum, and energy levels. The calibrated intensity numbers in the first column represent the relative radiant power emitted by our arc at each wavelength. Lines which differ in profile from a normal sharp symmetrical shape are described in the second column, with the notation suggested in the Transactions of the Joint Commission for Spectroscopy [34] as follows:

b — band head,
c — complex,
d — unresolved double line,
h — hazy,
l — shaded longward,
s — shaded shortward,
w — wide.

The wavelengths in column 3 are taken from the places noted in the list of references and are given to the nearest 0.01 A. They are all normal air wavelengths, even those below 2000 A. Column 4 gives the spectrum, I, II, or III (respectively from neutral, singly ionized and doubly ionized atoms) in which the line occurs and column 5 the numerical values, rounded off to the nearest wavenumber, of the levels between which the transition occurs. These data are taken from the *Classification* reference.

The wavelength of a doubly classified line appears before the first pair of energy levels and the second pair follows immediately. In these tables all energy levels are given in vacuum wavenumber units, cm^{-1}, for which the name kayser (K) has been proposed [35]. For all spectral lines explained as transitions between energy levels this serves as a mutual check since the wavelengths in normal air, when converted to vacuum wavenumbers by a conversion table [36], will coincide within one unit with the difference between the two energy levels. Furthermore these numbers serve as an index to the term designation in "Atomic Energy Levels" [37] where electron configurations, quantum numbers, and magnetic splitting factors are given.

A comparison of the excitation energies of any two classified lines may be made by directly comparing their larger energy levels in kaysers, and adding the ionization potentials in the case of lines from II or III spectra. This direct and simple procedure avoids the labor of converting all energy levels from kaysers to electron volts by means of the relation one ev = 8066 K.

In part II the intensity data are arranged in two tables in order of increasing wavelengths. In table 1 the strong lines of each element which were abstracted from the main tables in part I are here ar-

ranged in order of wavelength. Following this is table 2 in which the individual main tables of part I have been consolidated into a single table arranged by wavelength. This table contains about 39,000 lines of 70 elements. The intensities in the table are on a scale of relative radiant power and the scale is the same from element to element. Following the intensity numbers are given the wavelength, the element symbol, and the spectrum. The intensity of a double line appears before the first wavelength and the second wavelength follows immediately.

This investigation has extended over a period of 28 years, and represents a very considerable amount of intermittent labor contributed mainly by a relatively small number of individuals. The program was initiated by Meggers and Scribner, the latter prepared diluted-element mixtures, electrodes and spectrograms, while the former identified wavelengths, supplied many line classifications, and estimated relative intensities of some fifty thousand lines. In the production of the mixtures and the copper electrodes and spectrograms valuable assistance was given by Harriet E. Brown. Corliss contributed the copper calibration, the conversion of apparent intensities to relative radiant powers, and prepared the final tables. Mrs. Ruth Peterson carefully prepared and checked all the data on IBM cards so that it could be printed automatically. Valuable advice and assistance on the IBM machine operations was given by William Bozman. To all our able and reliable assistants the authors extend their sincere appreciation and thanks for cheerful and conscientious cooperation.

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WASHINGTON, D. C., January 1, 1961.

Table 1.

The Strong Lines

in Order of Wavelength

Table 1. Strongest Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
40	2039.85 Se I		170	2639.71 Ir I		1000	2795.53 Mg II	
1000	2138.56 Zn I		120	2641.41 Hf II		120	2797.70 Ir I	
1500	2288.02 Cd I		180	2644.11 Os I		650	2798.27 Mn I	
300	2348.61 Be I		280	2647.47 Ta I		480	2801.06 Mn I	
70	2385.76 Te I		1200	2651.18 Ge I		1000	2801.99 Pb I	
140	2400.63 Ta II		300	2653.27 Ta I		600	2802.70 Mg II	
200	2427.95 Au I		140	2653.74 Yb II		190	2802.84 Eu II	
160	2428.58 Re I		200	2656.54 W I		260	2806.91 Os I	
160	2435.96 W I		220	2656.61 Ta I		340	2813.94 Eu II	
110	2459.30 W I		180	2658.60 Os I		220	2816.15 Mo II	
65	2464.49 Yb I		280	2659.45 Pt I		140	2820.22 Hf II	
140	2466.85 W I		180	2661.34 Ta I		200	2820.78 Eu II	
120	2474.15 W I		130	2661.98 Ir I		140	2830.30 Pt I	
160	2475.12 Ir I		200	2664.79 Ir I		200	2831.38 W I	
10	2478.57 C I		90	2675.90 Ta II		70	2832.31 Th II	
100	2481.18 Ir I		340	2675.95 Au I		950	2833.06 Pb I	
160	2481.44 W I		200	2677.16 Cr II		280	2835.63 Cr II	
280	2483.27 Fe I		200	2678.63 Zr II		110	2837.30 Th II	
260	2488.15 Fe I		260	2681.41 W I		480	2838.63 Os I	
380	2488.55 Os I		180	2685.17 Ta II		1400	2839.99 Sn I	
480	2497.73 B I		200	2689.82 Os I		190	2843.25 Cr II	
220	2498.41 Os I		42	2692.42 Th II		220	2844.40 Os I	
200	2502.98 Ir I		220	2694.23 Ir I		220	2848.23 Mo II	
150 c	2508.99 Re I		150	2697.06 Nb II		280	2849.72 Ir I	
200	2513.25 Os I		120	2698.30 Ta I		170	2850.49 Ta II	
360	2516.11 Si I		200	2702.40 Pt I		220	2850.98 Ta I, II	
280	2522.85 Fe I		160	2705.89 Pt I		6000	2852.13 Mg I	
120 d	2526.35 Ta I		700	2706.51 Sn I		90	2860.44 As I	
	2526.45 Ta I		850	2709.63 Ge I		1000	2863.33 Sn I	
320	2528.52 Sb I		140	2710.13 Ta I		240	2866.37 Hf I	
60	2535.65 P I		280	2714.64 Os I		48	2870.40 Th II	
1500	2536.52 Hg I		300	2714.67 Ta I		220	2871.51 Mo II	
380	2543.97 Ir I		120	2715.47 Re I		140	2877.92 Sb I	
120	2547.14 W I		260	2718.90 W I		260	2881.60 Si I	
280	2551.35 W I		260	2719.02 Fe I		260	2887.68 Re I	
120	2559.43 Ta I		130	2719.04 Pt I		50	2889.63 U II	
44	2565.60 Th II		320	2724.35 W I		160	2890.99 Mo II	
1200	2576.10 Mn II		420	2727.78 Eu II		500	2891.38 Yb II	
800	2593.73 Mn II		180	2733.96 Pt I		90	2891.84 Ta I	
600	2598.05 Sb I		46	2747.16 Th II		420	2894.84 Lu II	
	2598.09 Sb I		140	2748.78 Ta I		190	2896.45 W I	
200	2599.40 Fe II		100	2749.83 Ta I		400	2897.98 Bi I	
550	2605.69 Mn II		180	2750.48 Yb II		200	2898.26 Hf I	
160	2608.63 Ta I		650	2754.59 Ge I		140	2904.41 Hf I	
1200	2615.42 Lu II		120	2758.31 Ta I		320	2906.68 Eu II	
110	2628.03 Pt I		440 d	2767.87 Tl I		320	2908.82 V II	
140	2635.58 Ta II		220	2775.40 Mo II		900	2909.06 Os I	
100	2636.90 Ta I		90	2775.88 Ta I		600	2911.39 Lu II	
360	2637.13 Os I		140	2780.22 As I		140	2911.92 Mo II	
120	2638.71 Hf II		800	2794.82 Mn I		200	2912.33 Os I	

Table 1. Strongest Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
220	2916.48 Hf I		120	3057.02 Hf I		550	3234.52 Ti II	
200	2919.79 Os I		900	3058.66 Os I		440	3236.57 Ti II	
160	2923.39 Mo II		320	3064.71 Pt I		42	3238.12 Th II	
320	2924.02 V II		320	3066.38 V I		800	3242.28 Y II	
220	2924.64 V II		160	3067.40 Re I		1200	3242.70 Pd I	
320	2924.79 Ir I		3600	3067.72 Bi I		5000	3247.54 Cu I	
170	2927.81 Nb II		160	3068.89 Ir I		1300 c	3256.09 In I	
170	2929.79 Pt I		240	3072.88 Hf I		65	3256.28 Th II	
140	2930.50 Mo II		500	3077.60 Lu II		320	3262.29 Os I	
200	2933.55 Ta I		48	3078.82 Th II		65	3262.67 Th II	
140	2940.22 Ta I		340 h	3081.47 Lu I		260	3264.79 Er II	
220	2940.77 Hf I		650	3092.71 Al I		320	3267.94 Os I	
55	2941.92 U II			3092.84 Al I		70	3272.25 Ce II	
200	2943.15 Ir I		500	3093.11 V II		2500	3273.96 Cu I	
300	2944.40 W I		220	3094.18 Nb II		200	3279.26 Zr II	
300	2946.98 W I		300	3100.50 Gd II		5500	3280.68 Ag I	
240	2949.20 Mn II		400	3102.30 V II		440	3281.74 Lu I	
140	2950.68 Hf I		340	3110.71 V II		110	3285.04 Tb ii	
170	2950.88 Nb II		170	3112.12 Mo I		44	3287.79 Th II	
120	2954.20 Hf I		260	3118.38 V II		140	3289.02 Mo I	
180	2963.32 Ta I		480	3130.42 Be II		2600	3289.37 Yb II	
160	2964.88 Hf I		180	3130.79 Nb II		65	3291.74 Th II	
90	2965.13 Ta II		320	3131.07 Be II		44	3292.52 Th II	
90	2965.54 Ta I		700	3131.26 Tm II		160	3293.07 Tb II	
140	2965.76 Re I		1800	3132.59 Mo I		800	3301.56 Os I	
280	2970.56 Yb II		340	3133.32 Ir I		140	3306.39 Sm II	
120	2980.81 Hf I		320	3156.25 Os I		140	3311.16 Ta I	
170	2986.00 Cr I		750	3158.16 Mo I		360	3312.11 Lu I	
240	2986.47 Cr I		140	3163.40 Nb II		220	3312.42 Er II	
160	2992.36 Re I		1100	3170.35 Mo I		90	3318.84 Ta I	
180	2997.97 Pt I		75	3180.20 Th II		360	3323.09 Rh I	
500	2999.60 Re I		420	3183.41 V I		400	3324.40 Tb II	
320	3002.49 Ni I		700	3183.98 V I		60	3325.12 Th II	
700	3009.14 Sn I		110	3184.76 Re I		600	3327.89 Y II	
300	3012.00 Ni I		500	3185.40 V I		100	3334.33 Eu I	
240	3012.54 Ta II		110	3185.57 Re I		44	3334.61 Th II	
120	3012.90 Hf II		55	3188.23 Th II		200	3337.49 La II	
180	3014.76 Cr I		950	3193.97 Mo I		44	3337.87 Th II	
120	3016.94 Hf II		70	3201.71 Ce II		200	3338.18 Re I	
360	3017.57 Cr I		110 c	3204.25 Re I		480	3341.88 Ti I, II	
460	3018.04 Os I		380	3208.83 Mo I		150	3341.97 Nb I	
130	3020.53 Hf I		110	3212.81 Eu I		160	3342.24 Re I	
280	3020.64 Fe I		130	3215.56 W I		150	3343.71 Nb I	
360	3021.56 Cr I		500	3216.69 Y II		160	3344.75 Mo I	
130	3031.11 Yb II		120	3218.93 Tb II		140	3345.02 Zn I	
850	3034.12 Sn I		130	3219.95 Tb II		360	3349.04 Ti II	
750	3039.06 Ge I		500	3220.78 Ir I		200	3349.06 Nb I	
800 c	3039.36 In I		220	3230.59 Er II		1000	3349.41 Ti II	
300	3040.90 Os I		200	3232.06 Os I		550	3350.47 Gd II	
280	3050.82 Ni I		140	3233.14 Mo I		70	3351.23 Th II	

Table 1. Strongest Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
900	3353.73 Sc II		700	3434.89 Rh I		440	3506.32 Co I	
200	3358.12 Mo I		55	3435.98 Th II		480 c	3507.39 Lu II	
200	3358.42 Nb I		650	3436.74 Ru I		600	3509.17 Tb II	
44	3358.60 Th II		750	3438.23 Zr II		48 d	3511.56 Th II	
440	3358.62 Gd II		280	3439.99 Gd II			3511.67 Th II	
440	3359.56 Lu I		400	3440.61 Fe I		300	3512.64 Co I	
600	3361.21 Ti II		460	3441.50 Tm II		320	3513.64 Ir I	
	3361.26 Ti I		550	3443.64 Co I		65	3514.61 U I	
550	3362.23 Gd II		340	3445.58 Dy II		600	3515.05 Ni I	
380	3362.62 Tm II		440	3446.26 Ni I		460 c	3515.59 Ho II	
360	3371.45 Ti I		400	3447.12 Mo I		1300	3516.94 Pd I	
600	3372.15 Sc II		1600 c	3451.88 Re I		300	3518.35 Co I	
750	3372.76 Er II		360	3453.14 Ho II		2000	3519.24 Tl I	
480	3372.80 Ti II		1300	3453.50 Co I		320	3519.60 Zr I	
360	3376.50 Lu I		460	3453.67 Tm II		140	3523.66 Tb II	
300	3380.57 Ni I		70	3454.07 Yb II		400	3523.98 Dy II	
200	3380.91 La II		1800 c	3456.00 Ho II		750	3524.54 Ni I	
2800	3382.89 Ag I		460	3458.47 Ni I		400	3526.85 Co I	
480	3383.76 Ti II		5500 c	3460.46 Re I		750	3528.02 Rh I	
240	3384.62 Mo I		400	3460.97 Dy II		500	3529.43 Tl I	
480	3385.03 Dy II		460	3461.65 Ni I		460	3529.81 Co I	
170	3385.08 Er II		500	3462.04 Rh I		2000	3531.70 Dy II	
900	3391.98 Zr II		800	3462.20 Tm II		400	3534.96 Dy II	
220	3392.00 Er II		320	3462.80 Co I		240	3535.30 Nb I	
90	3392.03 Th II		280	3463.98 Gd II		500	3536.03 Dy II	
300	3392.99 Ni I		340	3464.36 Yb I		150	3537.48 Nb I	
340	3393.59 Dy II		4000 c	3464.73 Re I		400	3538.50 Dy II	
480	3396.85 Rh I		320	3465.80 Co I		70	3539.09 Ce II	
900 c	3398.98 Ho II		95	3469.92 Th II		48	3539.59 Th II	
400	3399.30 Re I		400	3470.66 Rh I		120	3540.24 Tb II	
260	3399.80 Hf II		500	3474.02 Co I		440	3545.80 Gd II	
70	3402.70 Th II		600 c	3474.26 Ho II		280	3547.68 Zr I	
2600	3404.58 Pd I		400	3474.78 Rh I		500	3549.01 Y II	
700	3405.12 Co I		70	3476.31 Yb II		400	3549.36 Gd II	
160	3405.94 Mo I		70	3478.84 Yb II		400	3550.22 Dy II	
480	3407.79 Dy II		190	3479.39 Zr II		48	3550.82 U II	
280	3409.18 Co I		200	3481.15 Zr II		280	3551.95 Zr II	
420	3412.34 Co I		1100	3481.15 Pd I		1300	3553.08 Pd I	
750	3414.76 Ni I		700	3484.84 Ho II		340	3556.60 Zr II	
600	3416.46 Ho II		65	3489.37 U I		600	3558.55 Sc II	
320	3417.35 Ru I		300	3489.40 Co I		110	3560.80 Ce II	
1400	3421.24 Pd I		500	3492.96 Ni I		150	3561.66 Hf II	
700	3422.47 Gd II		400	3494.49 Dy II		340	3561.74 Tb II	
800	3424.62 Re I		280 c	3494.76 Ho II		48	3561.80 U	
600	3425.08 Tm II		650	3496.21 Zr II		460	3566.37 Ni I	
220 c	3425.34 Ho II		850	3498.94 Ru I		95	3566.60 U I	
220 c	3428.13 Ho II		650	3499.11 Er II		350	3568.27 Sm II	
500	3428.31 Ru I		600	3502.28 Co I		440	3568.51 Tb II	
280	3433.04 Co I		500	3502.52 Rh I		170	3568.98 Tb II	
70	3434.00 Th II		140	3505.23 Hf II		120	3569.04 Hf II	

Table 1. Strongest Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
550	3569.38 Co I	600	3619.39 Ni II	160	3697.85 Nb I
340	3569.49 Mn I	550	3620.94 Y I	400	3700.26 Tm II
400	3570.10 Fe I	140	3621.23 Sm II	650	3700.91 Rh I
340	3572.47 Zr II	80 d	3623.84 Ce II	320	3701.36 Tm II
1200	3572.53 Sc II	180	3623.86 Zr I	80	3701.52 U II
120	3573.72 Ir I	170	3624.46 Mo I	460	3702.85 Tb II
180	3575.85 Nb I	130	3626.62 Ta I	400	3703.58 V I
400	3576.25 Dy II	360	3630.25 Dy II	240	3703.92 Tb II
900	3576.35 Sc II	1800	3630.75 Sc II	85	3709.29 Ce II
200	3576.85 Zr II	200	3631.46 Fe I	85	3709.93 Ce II
95	3577.46 Ce II	1000	3633.12 Y II	1500	3710.30 Y II
2400	3578.69 Cr I	280	3634.29 Sm II	100 d	3711.74 Tb II
120	3579.20 Tb II	2200	3634.70 Pd I	260	3712.70 Gd II
600	3580.27 Nb I	300	3634.93 Ru I	340	3713.01 Nb I
700	3580.94 Sc II	400	3635.46 Ti I	110	3716.37 Ce II
600	3581.20 Fe I	48	3638.20 U I	650	3717.92 Tm I
170	3581.89 Mo I	550	3642.68 Ti I	42	3719.44 Th I
400	3583.10 Rh I	1200	3642.79 Sc II	600	3719.94 Fe I
130	3584.88 U I	600	3645.31 Sc II	55	3721.82 Th II
550	3584.96 Gd II	1000	3645.41 Dy II	1700 cw	3724.94 Eu II
300	3585.08 Dy II	600	3646.19 Gd II	400	3725.76 Re I
420	3587.19 Co I	240	3650.40 Tb II	280	3726.24 Nb I
650	3589.22 Ru I	600	3653.50 Ti I	800	3726.93 Ru I
350	3592.60 Sm II	380	3654.62 Gd II	1000	3728.03 Ru I
700	3593.02 Ru I	160	3655.85 Ce II	120	3728.47 Sm II
2100	3593.49 Cr I	300	3656.15 Gd II	650	3730.43 Ru I
650	3596.18 Ru I	700	3657.99 Rh I	160	3731.26 Sm II
400	3596.19 Rh I	200	3658.88 Tb II	700	3734.87 Fe I
500	3597.15 Rh I	55	3659.16 U I	120	3735.98 Sm II
170	3600.44 Tb II	80	3660.64 Ce II	340	3737.13 Fe I
1300	3600.73 Y II	600	3661.35 Ru I	220	3739.12 Sm II
550	3601.19 Zr I	180	3661.36 Sm II		3739.20 Sm II
800	3601.92 Y II	260	3664.60 Gd II	280	3739.80 Nb I
140	3604.28 Sm II	80	3667.98 Ce II	90	3741.19 Th II
1600	3605.33 Cr I	160	3670.07 U II	320	3742.28 Ru I
100	3607.41 Ta I	180	3670.84 Sm II	180	3742.39 Nb I
200	3608.86 Fe I	50	3675.57 Th II	440	3743.47 Gd II
70	3609.44 Th II	380	3676.35 Tb II	420	3744.07 Tm I
280	3609.49 Sm II	140	3680.60 Mo I	240	3745.56 Fe I
2200	3609.55 Pd I		3680.68 Mo I	260	3745.59 Ru I
360	3610.51 Cd I	220	3682.24 Hf I	50	3746.41 U II
1000	3611.05 Y II	1400	3683.48 Pb I	360 cw	3748.17 Ho II
180	3613.10 Zr II	300	3687.74 Gd II	70	3748.68 U II
2500	3613.84 Sc II	550	3688.42 Eu II	400	3749.49 Fe I
180	3614.77 Zr II	150 c	3691.48 Re I	360	3752.52 Os I
300	3616.58 Er II	800	3692.36 Rh I	46	3752.57 Th II
48 d	3617.02 Th II	700	3692.64 Er II	440	3752.86 Ti I
	3617.12 Th II	3200	3694.19 Yb II	100	3755.24 Tb II
240	3617.52 W I	400	3694.81 Dy II	400	3757.37 Dy II
200	3618.77 Fe I	160	3694.94 Mo I	300	3758.24 Fe I

Table 1. Strongest Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
280	3759.08 La II		140	3816.17 Pr II			3863.40 Nd II	
140	3760.69 Sm II		160	3817.48 W I		260	3863.87 Zr I	
500	3761.33 Tm II		3400 cw	3819.67 Eu II		2800	3864.11 Mo I	
400	3761.91 Tm II		500	3820.43 Fe I		140	3865.92 U II	
160	3765.14 Tb I		130	3820.73 Hf I		200	3867.98 W I	
850	3768.39 Gd II		240	3823.51 Mn I		110	3871.04 U I	
120	3768.45 W I		320	3825.88 Fe I		340	3871.64 La II	
1200	3774.33 Y II		120	3826.20 Sm II		600	3872.13 Dy II	
80	3775.50 Nd II		55	3826.51 U II		46	3874.04 U	
1200 cw	3775.72 Tl I		140	3830.29 Tb II		320 w	3874.19 Tb II	
190	3776.49 Tb II		320	3830.53 Er II		180 c	3877.23 Pr II	
140	3777.64 Hf I		100	3830.72 Pr II		46	3878.09 U	
120	3780.77 W I		150	3831.46 U II		90	3878.37 Ce II	
200	3782.20 Os I		160	3833.75 Mo I		75	3881.46 U II	
140	3782.84 U II		120	3835.05 W I		120	3882.45 Ce II	
280	3783.05 Gd I		280	3835.96 Zr I		500	3883.13 Tm I	
140	3784.25 Nd II		90	3838.54 Ce II		280	3885.29 Sm II	
140	3785.46 Hf I		100	3838.98 Nd II		400	3887.35 Tm I	
360	3786.06 Ru I		90	3839.62 U I		340 c	3888.96 Ho II	
280	3786.21 Dy II		60	3839.74 Th II		75	3889.93 Nd II	
70	3786.63 Ce II		280	3840.75 V I		85	3889.99 Ce II	
160	3786.84 Er II		120	3843.50 Sm II		260	3890.32 Zr I	
180	3787.06 Nb I		300	3845.47 Co I		160	3890.36 U II	
110	3788.12 Sm II		750	3848.02 Tm II		75	3890.58 Nd II	
850	3788.70 Y II		100 d	3848.24 Nd II		75	3890.94 Nd II	
140	3790.15 Nb I			3848.31 Nd II		1500 c	3891.02 Ho II	
550	3790.51 Ru I		90	3848.52 Nd II		180	3891.38 Zr I	
440	3790.83 La II		70	3848.60 Ce II		46	3892.68 U II	
360	3791.21 Nb I		340	3848.76 Tb II		340	3892.69 Er I	
120	3793.97 Sm II		320	3850.69 Gd II		340	3894.08 Co I	
460	3794.78 La II		120 c	3850.83 Pr II		420	3896.25 Er II	
600	3795.76 Tm II		500	3850.97 Gd II		120	3896.98 Sm II	
500	3796.37 Gd II		140 d	3851.66 Nd II		500	3898.54 Dy II	
1000 c	3796.75 Ho I			3851.74 Nd II		220	3899.20 Tb II	
120	3797.73 Sm II		420	3852.45 Gd II		46	3899.78 U II	
280	3798.12 Nb I		100	3852.81 Pr II		120	3900.21 Nd II	
3200	3798.25 Mo I		70	3853.16 Ce II		150	3901.35 Tb I	
700	3798.90 Ru I		200 c	3854.07 Ho II		75	3901.84 Nd II	
420	3799.31 Rh I		100	3854.19 Ce II		1800	3902.96 Mo I	
700	3799.35 Ru I		200	3854.21 Sm II		100	3905.89 Nd II	
320	3800.12 Ir I		46	3854.22 U I		850	3906.34 Er II	
200	3801.53 Ce II		100	3854.32 Ce II		2400 cw	3907.10 Eu II	
280	3802.92 Nb I		180	3854.66 U II		1800	3907.49 Sc I	
42	3803.07 Th I		320	3855.84 V I		320	3908.43 Pr II	
150	3805.36 Nd II		500	3856.52 Rh I		120	3911.16 Nd II	
360	3806.72 Mn I		360	3859.58 U II		2100	3911.81 Sc I	
85	3808.12 Ce II		420	3859.91 Fe I		130 c	3918.86 Pr II	
1000 c	3810.73 Ho I		300 c	3861.68 Ho II		160	3919.16 Cr I	
140	3812.00 U I		600	3862.82 Er I		170	3922.40 Sm II	
360	3813.97 Gd II		220 d	3863.33 Nd II		100	3925.46 Pr II	

Table 1. Strongest Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
300	3925.92 Ru I		220	4012.25 Nd II		50	4086.52 Th II	
130	3928.28 Sm II		190	4012.39 Ce II		550	4086.72 La II	
220	3929.22 La II		300	4019.13 Th II		280	4087.65 Er I	
42	3929.67 Th II		1800	4020.40 Sc I		160	4090.14 U II	
2800 cw	3930.48 Eu II		240	4020.52 Er I		750	4094.19 Tm I	
4200	3933.67 Ca II		1800	4023.69 Sc I		50	4094.75 Th II	
260	3937.02 Er I		2000	4030.76 Mn I		240	4098.61 Gd II	
170	3938.65 Er II		280	4031.69 La II		220	4099.80 V I	
120	3941.51 Nd II		1000	4032.98 Ga I		260 c	4100.75 Pr II	
140	3942.15 Ce II		190	4033.06 Tb II		700	4100.92 Nb I	
190	3942.75 Ce II		1400	4033.07 Mn I		1700 c	4101.76 In I	
90	3943.82 U I		800	4034.49 Mn I		1000	4102.38 Y I	
260	3944.41 Er I		150	4040.76 Ce II		110	4102.70 W I	
850	3944.70 Dy II		180	4040.80 Nd II		320	4103.34 Dy II	
380	3948.67 Ti I		300	4040.81 Ho I		1000	4103.84 Ho I	
900	3949.10 La II		420	4041.36 Mn I		220	4105.17 V I	
120	3951.16 Nd II		75	4042.76 U I		700	4105.84 Tm I	
220	3952.54 Ce II		300	4042.91 La II		60	4108.42 Th II	
70	3956.28 Ce II		600 c	4045.44 Ho II		320	4108.62 Ho I	
380	3956.34 Ti I		300	4045.82 Fe I		80	4109.08 Nd II	
440	3958.21 Ti I		1000	4045.99 Dy I		150	4109.46 Nd II	
900	3961.53 Al I		120	4050.04 U II		700	4111.78 V I	
80	3963.12 Nd II		240	4053.64 Gd I		340	4115.18 V I	
160	3963.69 Cr I		900	4053.93 Ho I		60	4116.10 U II	
140 c	3964.83 Pr II		200	4054.85 Pr II		75	4116.71 Th II	
100 c	3965.26 Pr II		200	4056.54 Pr II		150 c	4118.48 Pr II	
1100	3968.42 Dy II		3400	4057.83 Pb I		130	4118.55 Sm II	
2200	3968.47 Ca II		240	4058.22 Gd I		440	4123.23 La II	
220	3973.04 Er I		1700	4058.94 Nb I		550	4123.81 Nb I	
260	3973.60 Er I		280	4061.09 Nd II		70	4123.87 Ce II	
200 d	3976.84 Tb II		120	4061.59 Tb I		480	4127.16 Ho I	
2000 cw	3978.96 Eu II		65	4062.55 U II		70	4127.37 Ce II	
400	3981.76 Ti I		300	4062.82 Pr II		240	4128.07 V I	
170	3981.89 Tb II		65	4069.20 Th II		900	4128.31 Y I	
190 c	3982.06 Pr II		220	4069.88 Mo I		2200 cw	4129.70 Eu II	
85	3985.80 U II		75	4071.81 Ce II		240	4132.02 V I	
1900	3987.98 Yb I		180	4072.70 Zr I		190	4133.80 Ce II	
440	3988.52 La II		130	4073.48 Ce II		220	4135.78 Os I	
120	3989.72 Pr II		550	4074.36 W I		180	4136.45 Re I	
480	3989.76 Ti I		110	4075.71 Ce II		240	4137.10 Nb I	
85	3990.10 Nd II		110	4075.85 Ce II		140	4137.65 Ce II	
140	3994.83 Pr II		280	4077.35 La II		280	4139.71 Nb I	
360	3995.75 La II		950	4077.38 Y I		130 c	4141.26 Pr II	
650	3998.64 Ti I		4600	4077.71 Sr II		750	4142.85 Y I	
200	3999.24 Ce II		600	4077.98 Dy II		240	4143.14 Pr II	
650	4000.48 Dy II		260	4078.70 Gd I		280	4143.55 Mo I	
180	4005.57 Tb II		1200	4079.73 Nb I		100	4144.46 Tb II	
1100	4007.97 Er I		550	4080.60 Ru I		70	4149.94 Ce II	
170	4008.71 Pr II		180	4081.22 Zr I		550	4151.10 Er I	
950	4008.75 W I		50	4085.04 Th II		100	4151.97 Ce II	

Table 1. Strongest Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
460	4152.58 Nb I		120	4247.38 Nd II		150	4408.84 Pr II	
65	4153.97 U I		75	4248.68 Ce II		240	4411.57 Mo I	
180	4156.08 Nd II		1700	4254.35 Cr I			4411.70 Mo I	
900	4163.03 Ho I		440	4260.85 Os I		70	4418.78 Ce II	
460	4163.66 Nb I		150	4269.39 W I		440	4420.47 Os I	
150 c	4164.19 Pr II		1300	4274.80 Cr I		200	4424.34 Sm II	
420	4164.66 Nb I		150	4280.79 Sm II		200	4429.90 La II	
90	4165.61 Ce II		50	4282.04 Th II		110	4433.88 Sm II	
460	4167.99 Dy I		850	4289.72 Cr I		120	4434.32 Sm II	
360	4168.13 Nb I		140	4289.94 Ce II		900 cw	4435.56 Eu II	
100	4171.59 U II		450	4294.61 W I		80	4451.57 Nd II	
2000	4172.06 Ga I		140	4296.67 Ce II		170	4460.21 Ce II	
280	4173.23 Ho I		110	4296.74 Sm I		150	4467.34 Sm II	
140	4177.32 Nd II		340	4297.71 Ru I		100	4471.24 Ce II	
800	4177.54 Y II		100	4297.76 Pr II		1800 c	4511.31 In I	
44	4178.06 Th II		240	4302.11 W I		260	4513.31 Re I	
460	4179.42 Pr II		320	4303.58 Nd II		340	4518.57 Lu I	
250	4186.60 Ce II		130	4305.76 Pr II		200	4522.57 Eu II	
950	4186.78 Dy I		500	4305.92 Ti I		500	4533.24 Ti I	
650	4187.62 Tm I		200	4318.85 Tb I		46	4543.63 U II	
240	4188.32 Mo I		130	4318.94 Sm II		6500	4554.03 Ba II	
220	4189.52 Pr II		240 d	4325.57 Gd II		500	4554.51 Ru I	
550	4194.85 Dy I			4325.69 Gd I		150	4562.36 Ce II	
80	4198.67 Ce II		280	4326.47 Tb I		75	4572.28 Ce II	
	4198.72 Ce II		120	4329.02 Sm II		750	4594.03 Eu I	
700	4199.90 Ru I		460	4333.74 La II		650	4607.33 Sr I	
440	4203.73 Tm I		120	4333.91 Pr II		650	4627.22 Eu I	
4000 cw	4205.05 Eu II		70	4337.78 Ce II		120	4628.16 Ce II	
220 c	4206.74 Pr II		160	4338.45 Tb I		550	4661.88 Eu I	
44	4208.89 Th II		50	4341.69 U II		110	4674.60 Sm II	
1300	4211.72 Dy I		160	4344.51 Cr I		200	4687.80 Zr I	
500	4212.06 Ru I		190	4351.77 Cr I		140	4810.53 Zn I	
300	4215.15 Dy I		100	4351.85 Pr II		220 cw	4889.14 Re I	
3200	4215.52 Sr II		400	4358.35 Hg I		2000	4934.09 Ba II	
360	4218.09 Dy I		110	4368.33 Pr II		550	4981.73 Ti I	
360	4221.10 Dy I		220	4372.21 Ru I		440	4991.07 Ti I	
110	4222.60 Ce II		360	4374.80 Rh I		380	4999.51 Ti I	
340	4222.98 Pr II		1200	4374.94 Y II		75	5130.60 Nd II	
340	4225.33 Pr II		950	4379.24 V I		440	5204.52 Cr I	
440	4225.85 Gd I		180	4381.64 Mo I		700	5206.04 Cr I	
1100	4226.73 Ca I		90	4381.86 Th II		900	5208.44 Cr I	
220	4227.04 Ho I		550	4384.72 V I		80	5249.59 Nd II	
360 c	4227.46 Re I		380	4389.97 V I		130	5270.95 Re I	
180	4227.76 Zr I		110	4390.86 Sm II		160 cw	5275.56 Re I	
75	4232.38 Nd II		80	4391.11 Th II		75	5293.17 Nd II	
140	4232.59 Mo I		120	4391.66 Ce II		2000	5350.46 Tl I	
180	4239.31 Zr I		280	4395.23 V I		480	5506.49 Mo I	
70	4239.91 Ce II		220	4407.64 V I		320	5533.05 Mo I	
75	4241.67 U II		280	4408.20 V I		650	5535.48 Ba I	
1400	4246.83 Sc II		360	4408.51 V I		140	5556.48 Yb I	

Table 1. Strongest Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
150	5570.45	Mo I	160	6645.11	Eu II	75	7699.49	Yb I
2000	5889.95	Na I	3600	6707.84	Li I	3000	7800.23	Rb I
1000	5895.92	Na I	120	7370.22	Eu II	1500	7947.60	Rb I
2000	6141.72	Ba II	1800	7664.91	K I	1500	8521.10	Cs I
1200	6496.90	Ba II	900	7698.98	K I	800	8943.50	Cs I

Table 2.

All Observed Lines

in Order of Wavelength

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
17	1936.96	As I	5	2026.08	W II	4	2071.21	W II
17	1953.89	Bi I	8	2028.18	Hf II	7	2073.08	Sn I
11	1954.49	Ge I	10	2028.23	Os I	5	2074.70	Re I
3.5	1959.48	Bi I	5	2029.32	Nb II	3.0	2074.79	Se I
34	1960.26	Se I	2.5	2029.49	Sb I	2.5	2075.59	W II
8	1961.40	Ge I	10	2029.98	W II	4	2076.43	Ru I
14	1970.26	Ge I	3.0	2030.63	Pt I	9	2076.95	Os I
11	1970.80	Sn I	4	2032.41	Pt I	9	2078.09	Os
28	1971.97	As I	5	2032.99	Nb II	12	2079.11	W II
8 h	1983.55	Sn I	7	2033.57	Ir I	18	2079.97	Os I
8	1987.64	Ge I	14	2034.44	Os I	10	2081.03	Te I
20	1989.70	As I	2.0	2035.03	W II	9	2081.68	Mo II
6	1990.48	As I	1.5	2035.84	Cu II	4	2082.54	Os I
8	1994.2	Te I	2.0	2037.12	Cu II	3.0	2083.22	Ir I
3.0	1994.78	As I	24	2038.44	Mo II	5	2083.77	Ru I
6	1995.40	Mn I	5	2039.77	Sb I	5	2083.92	Re I
26	1998.25	Ge I	40	2039.85	Se I	5	2084.12	Fe I
9	1998.86	Mn I	8	2040.66	Sn I	5	2084.59	Pt I
3.5	1999.69	Cu II	24	2041.69	Ge I	14	2085.59	Re I
5	2001.45	Os I	16	2043.76	Ge I	2.5	2085.74	Ir I
3.0	2001.71	W II	4	2043.79	Cu II	7	2086.00	Ge I
16	2002.0	Te I	24	2045.36	Os	5	2088.19	W
28	2003.34	As I	24	2045.98	Mo II	13	2088.82	Ir I
13	2003.53	Re I	7	2048.28	Os I	7	2088.93	B I
7	2003.73	Os I	24	2049.08	Re I	4	2089.03	Os I
12	2003.82	Mn I	6	2049.37	Pt I	3.0	2089.14	W II
5	2004.78	Os	7	2049.42	Os I	4	2089.21	Os I
8	2008.07	W II	14	2049.57	Sb I	5	2089.52	Mo II
4	2009.19	As I	5	2049.63	W II	11	2089.59	B I
3.0	2009.98	W II	3.5	2052.22	Ir I	2.5	2090.48	W
10	2010.15	Os	8	2053.27	Pb I	5	2090.89	Ru I
2.5	2010.23	W II	5	2054.45	Ge I	10	2091.58	Sn I
3.5	2010.65	Ir I	22	2055.52	Cr II	3.0	2092.13	Mn I
8	2012.00	Au I	2.5	2057.23	Ge I	7	2092.41	Re II
5	2012.78	Hf II	9	2058.69	Os	5	2092.44	V I
3.0	2013.32	As I		2058.78	Os I	5	2092.50	Mo II
2.5	2014.23	W II	3.0	2060.64	Ir I	13	2092.63	Ir I
18	2015.11	Mo II	18	2061.49	Cr II	9	2093.11	Mo II
10	2017.87	Re I	14	2061.69	Os I	36	2094.23	Ge I
19	2018.14	Os I	55	2061.70	Bi I	9	2094.75	W II
13	2019.05	Ge I	13	2061.91	Zn II	2.5	2096.18	Hf II
19	2020.26	Os	15	2062.79	Se I	2.5 h	2096.39	Sn I
40	2020.30	Mo II	10	2065.20	Ge I	14	2097.12	Re I
8	2021.21	Bi I	12	2065.42	Cr II	9	2097.60	Os I
2.0	2021.38	Au I	2.5	2065.57	W II	10	2098.41	Sb I
5	2022.02	Pb I	9	2067.21	Os II	4	2098.60	W
3.5	2022.35	Ir I	2.0	2067.50	Pt I	9	2100.63	Os I
10	2022.76	Os I	55	2068.33	Sb I	3.5	2100.67	W II
2.0	2024.34	Cu I	34	2068.65	Ge I	7	2100.84	Mo II
2.5	2025.51	Zn II	5	2070.67	Os II	3.0	2100.93	Sn I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
2.5	2101.54	W	60	2144.38	Cd II	8	2178.94	Cu I
2.0	2103.33	Pt I	10	2144.86	Sb I	7	2179.19	Sb I
4	2104.29	Mo II	5	2146.87	Ta II	6	2181.72	Cu I
5	2105.80	Ge I	11	2147.19	Te I	6	2182.71	Ta II
2.5	2106.18	W II	6	2148.22	Ir I	2.0	2182.90	W I
3.5	2108.02	Mo II	2.0	2148.73	Sn I	4	2184.68	Os I
5	2109.22	Re I	9	2149.11	P I	6	2185.70	Yb II
8	2109.42	Nb II	7	2149.97	Os	4	2187.43	Ir II
4	2109.58	Mn	4	2150.54	Ir I	1.2	2187.87	La II
10	2110.26	Bi I	2.5	2150.62	Ta II	3.0	2190.38	Ir II
2.5	2110.34	W II	5	2151.43	Sn I	2.0	2191.64	Ir I
1.5	2112.09	Cu II	6	2152.68	Ir II	3.5	2191.84	Fe I
3.0	2112.68	Ir I	5	2152.84	Sr II	2.0	2192.26	Cu II
12	2113.93	Sn I	1.0	2152.95	P I	3.0	2193.20	Ta II
8	2116.65	Yb II	2.5	2153.56	W II	6	2193.88	Ta II
4	2117.66	Os I	2.0	2154.08	P I	4	2194.39	Os II
9	2117.96	Os I	8	2154.59	Os I	9	2194.49	Sn I
2.5	2118.48	Sb I	5	2155.81	Ir I	2.0	2194.52	W II
4	2118.87	W II	11	2156.67	Re I	7 h	2195.54	Lu II
2.0	2119.54	Ir I	2.5	2157.80	W II	9	2196.03	Ta II
13	2119.79	Os	4	2157.84	Os I	3.5	2196.04	Fe I
5	2121.59	W II	15	2158.05	Ir I	20	2198.70	Ge I
4	2123.84	Os I	4	2158.53	Os I	13	2199.34	Sn I
6	2124.11	Si I	1.4	2159.79	Te I	10 d	2199.58	Cu I
2.5	2124.75	Ge I	8	2161.00	Os		2199.75	Cu I
8	2125.21	Nb II	2.0	2161.60	Yb II	9	2199.67	Ta II
2.5	2125.44	Ir I	4	2162.88	Ir I	2.5	2201.32	Sb I
5	2126.54	Nb II	2.5	2165.01	Ta II	2.5	2202.22	Pt I
11	2126.72	Yb II	6	2165.09	Cu I	4	2202.49	Os I
6	2126.81	Ir II	2.5	2165.17	Pt I	9	2203.53	Pb II
5	2127.39	Sb I	2.0	2165.52	As I	7	2204.48	W II
2.5	2127.52	Ir I	6	2165.96	Sr II	3.5	2207.14	Ta II
6	2127.94	Ir I	5	2166.32	W II	2.0	2207.97	Si I
2.5	2128.61	Pt I	15	2166.77	Fe I	3.0	2208.09	Ir II
8	2131.18	Nb II	11	2166.90	Os I	7	2208.45	Sb I
7	2133.63	Bi I	4	2167.75	Os	2.0	2208.81	Mn I
1.0	2135.47	P I	17	2167.94	Re I	22	2209.65	Sn I
6	2135.98	Cu II	12	2169.42	Ir II	9 d	2210.03	Ta II
10	2136.20	P I	22	2169.99	Pb I		2210.19	Ta II
13	2137.11	Os I	8	2171.65	Os I	4	2210.82	Hf II
2.0	2138.53	Cu I	2.0	2174.60	Co I	2.0	2210.88	Si I
1000	2138.56	Zn I	7	2174.67	Pt I	2.0	2211.05	Sn I
9	2139.04	Re II	5.0 h	2174.94	Be I	4	2213.85	Mn I
10	2139.69	Sb I		2175.07	Be I	24 c	2214.26	Re II
3.5	2140.13	Ta II	10	2175.24	Ir I	4	2214.58	Cu I
5	2141.83	Sb I	38	2175.81	Sb I	13	2214.58	Re I
4	2142.74	Re II	13	2176.21	Re I	3.0	2215.60	Ta II
	2142.97	Re I	3.5	2178.03	Ta II	3.5	2216.67	Si I
55	2142.75	Te I	7	2178.09	Fe I	5	2220.37	Ir I
6	2144.23	Pt I, II	6	2178.17	Ir I	5	2220.73	Sb I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
3	2221.07	Ir II	6	2259.04	Te I	5	2282.19	Ta II
6	2221.83	Mn I	4	2259.53	Ru I	18	2282.26	Os II
2.5	2222.61	Pt I	10	2261.42	Ta II	1.6	2283.52	Co II
7	2224.45	Yb II	3.0	2261.62	Ta II	11	2283.67	Os I
2.5	2224.93	Sb I	13	2262.30	Ta II	2.5	2284.60	Ir I
3.5	2225.70	Cu I	7	2262.51	Sb I	6	2284.80	Tm II
12	2226.42	Re I	20	2264.39	Re I	1.6	2284.85	Co I
8	2227.78	Cu I	15	2264.60	Os I	2.0	2284.90	W I
4	2227.98	Os I	5	2264.61	Ir I	2.0	2285.02	Ta II
3.0	2228.25	Bi I	110	2265.02	Cd II	4	2285.17	W I
10	2230.08	Cu I	7	2266.33	Ir I	12	2285.25	Ta II
14	2230.61	Bi I	3.5	2266.83	Hf II	3.0	2285.38	Ru I
4	2231.72	Sn I	6	2267.19	Sn I	26	2286.16	Co II
8	2234.61	Os I	2.0	2267.47	Cd I	9	2286.59	Ta II
7	2235.44	Re I	1.6	2268.17	Co I	10	2286.68	Sn I
4	2236.17	Lu III	4	2268.28	Os I	4	2287.27	Ta II
13	2239.48	Ta II	2.5	2268.84	Pt I	40	2287.51	Re I
12	2242.68	Ir II	7	2268.90	Ir I	5	2287.81	Co I
3.5	2243.06	Y II	42	2268.91	Sn I	1500	2288.02	Cd I
3.0	2245.13	Co II	7 d	2269.09	Al I	44	2288.12	As I
3	2245.76	Ir II		2269.21	Al I	1.6	2288.57	Rh I
42	2246.05	Sn I	3.0	2269.56	Ta II	2.0	2288.98	Sb I
2.0	2246.88	Pb I	7	2269.69	Mo II	16	2289.16	Ta II
4	2247.00	Cu II	11	2270.17	Os I	2.5	2289.27	Pt I
2.5	2248.48	Ta II	2.0	2270.24	W II	8	2289.32	Os I
4	2248.75	W II	1.0	2271.37	W I	18	2289.98	Ni I
1.6	2249.30	Pt I	10	2271.85	Ta II	1.6	2291.46	Co I
5	2249.79	Ta II	12	2272.09	Ru I	2.0	2292.00	Co II
4	2249.84	W I	13	2272.59	Ta II	2.5	2292.40	Pt I
13	2250.76	Ta II	2.0	2272.61	Ti I	3.0	2292.54	Ta II
2.0	2251.17	Sn I	2.5	2273.28	Ti I	2.0	2293.39	Co II
12	2252.15	Os I	4	2274.38	Pt I	7	2293.44	Sb I
11	2253.38	Ir I	1.6	2274.49	Co I	5	2293.84	Cu I
	2253.49	Ir I	24	2274.62	Re I	0.6	2294.20	Ga I
4	2254.01	Hf II	60 c	2275.25	Re II	40	2294.49	Re I
3.0	2254.86	Ta II	1.6	2276.21	Rh II	8 d	2294.49	W I
11	2255.10	Ir I	5	2276.53	Co I		2294.54	W II
2.0	2255.15	Hf II	5	2276.58	Bi I	3.0	2295.08	Ir I
9	2255.52	Ru I	2.0	2276.70	Ti I	3.0	2295.18	Ta
4	2255.73	Re I	1.0	2276.94	Lu II	2.0	2295.23	Co I
5	2255.77	Ta II	10	2277.16	Hf II	12	2295.68	Nb II
8	2255.81	Ir I	6	2277.58	W I	1.6	2296.05	Co I
19	2255.85	Os I, II	4	2278.19	Ru I	3.5	2296.71	Co I
2.0	2256.00	Ge I	14	2279.57	Ru I	6	2297.31	Os I
8	2256.19	Re I	3.0	2279.85	Ta I	2.5	2297.41	Lu II
4	2256.51	Ta II	3.0	2279.96	Ti I	18	2297.78	La III
8	2256.76	La II	5	2280.00	Ir I	4	2297.79	Fe I
2.0	2258.51	Ir I	7	2281.02	Ir II	7	2298.05	Ir I
6	2258.71	Ta II	20	2281.62	Re I		2298.16	Ir I
8	2258.86	Ir I	5	2281.91	Ir I	6	2298.09	Re II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
4	2298.28	W I	16	2314.05	Co II	2.5	2326.10	Pt I
4	2299.53	Ir I	4	2314.18	W I	8	2326.14	Co II
6	2299.77	Re I	4	2314.20	Ge I	2.5	2326.47	Rh I
3.0	2299.85	Ti I	13	2314.98	Co II	8	2326.48	Co II
8	2300.50	Ir I	3.5	2315.02	W II	8 d	2326.56	W I
8	2300.78	Ni I	5	2315.38	Ir I		2326.71	W I
3.0	2301.47	Ta II	9	2315.46	Ta II	3.0	2326.93	Th II
10	2302.08	Nb II	2.0	2315.50	Pt I	7	2326.99	Os I
9	2302.24	Ta II	3.0	2315.98	Tl I	6	2327.90	Ge I
7	2302.54	Ru I	7	2316.04	Ni II	2.5	2327.98	Ir I
3.0	2302.73	Ti I	4	2316.16	Co I	1.4	2328.31	W II
9	2302.93	Ta II	5	2316.86	Co I	1.4	2328.64	Rh I
10	2302.99	Re I	22	2317.16	Ni I	6	2328.66	Re I
6	2303.49	Ta II	50	2317.23	Sn I	1.8	2328.75	La II
4	2303.83	W II	13	2317.80	Ru I	1.6	2329.10	Co II
1.6	2303.97	Co I	1.8	2317.82	La II	8 h	2329.28	Cd I
2.5	2304.18	Co I	5	2318.29	Pt I	3.5	2329.78	Tm II
26	2304.22	Ir I	1.0	2318.36	Rh I	17	2329.96	Ni I
28	2304.24	Ba II	2.0	2318.94	W I	6	2330.35	Co II
4	2304.25	Mo II	1.6	2319.10	Rh I	8	2330.46	Mo I
3.0	2305.18	Co I	6	2319.16	Ta II	2.5	2331.29	Ta II
4	2305.47	Ir I	4	2319.19	Re I	4	2331.30	W I
4	2305.67	Ti I	4	2319.44	La II	2.0	2331.37	Ag II
3.5	2306.06	In II	44	2320.03	Ni I	7	2331.78	Tm III
4	2306.46	Sb I	7	2320.16	Re I	1.6	2331.92	W I
11	2306.54	Re I	11	2320.18	Os I	18	2331.98	Ta II
4	2306.60	W I	5	2320.81	Yb II	4	2332.12	Mo II
8	2306.61	Cd I	6	2321.14	Hf II	15	2332.19	Ta II
4	2306.97	Mo II	30	2321.38	Ni I	2.0	2332.44	Pb I
2.0	2307.27	Ir I	5	2321.45	Ir I	1.6	2332.76	W
24	2307.86	Co II	5	2321.58	Ir I	7	2332.80	Fe II
5	2308.04	Pt I	9	2321.63	W I	6	2332.97	Hf II
11	2308.31	Os I	1.6	2321.73	Rh I	7	2333.30	Ir I
2.0	2308.46	Ta II	4	2322.01	Ru I	3.0	2333.77	W II
9	2308.93	Ir I	16	2322.47	Hf II	10	2333.84	Ir I
24	2309.02	Co I	15	2322.49	Re I	3.0	2334.13	Ta II
6	2309.04	W I	6	2322.58	Rh I	6	2334.33	Re I
1.6	2309.82	Rh I	4	2322.68	Ni I	8	2334.50	Ir I
30	2310.96	Ni I	24	2323.14	Co I	7	2334.56	Os I
45	2311.47	Sb I	8	2323.25	Hf II	4	2334.77	Rh II
16	2311.60	Co II	6	2323.98	Os I	38	2334.80	Sn I
26	2312.34	Ni I	13	2324.24	Os I	5	2334.88	Ta II
9	2312.60	Ta II	8	2324.32	Co II	4	2334.96	Ru II
4	2312.84	Cd II	3.0	2324.50	Hf II	55	2335.27	Ba II
4	2312.97	Re I	8	2324.89	Hf II	6	2335.73	Re I
8	2313.19	W I	3.5	2325.51	Os I	4	2335.75	Ta II
4	2313.34	Re I	6	2325.55	Co I	16	2335.99	Co I
22	2313.66	Ni I	26	2325.79	Ni I	5	2336.10	Re I
3.5	2313.75	Os II	4	2325.94	Mo I	17	2336.80	Os II
22	2313.98	Ni I	6	2326.09	W II	6	2337.33	Hf II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
9	2337.49 Ni I			2349.32 W I		1.8	2358.07 W I	
3.0	2337.82 Ni I		7	2349.34 Ru I		7	2358.16 Ir I	
8	2337.94 Co II		6	2349.39 Re I		8	2358.18 Co I	
6	2337.95 Re I		85	2349.84 As I		4	2358.51 Er II	
4	2338.00 Fe II		6	2350.23 Os II		1.8	2358.81 W II	
2.0	2338.28 Ga I		2.5	2350.28 Co I		4	2359.10 Fe II	
9	2338.28 Ta II		3.5 d	2350.37 W II		6	2359.16 Ta II	
7	2338.36 Tm III			2350.46 W I		1.4	2359.18 Rh I	
11	2338.63 Os I		6 d	2350.46 Re I		4	2360.00 Fe II	
20	2338.67 Co I		20	2351.22 Hf II		3.5	2360.29 Fe II	
6	2339.05 Co I		12	2351.33 Ru I		18	2360.43 W I	
5	2340.18 Pt I		2.0	2351.39 Co I		2.0	2360.50 Sb I	
7	2340.47 Mo I		1.6	2351.55 Os I		6	2360.56 Ru I	
7	2340.69 Os I		1.6	2351.72 Os I		4	2360.63 Ni I	
8	2340.69 Ru I		3.0	2351.99 Ta II		9	2360.73 Ir I	
2.5	2340.93 Tm II		18	2352.07 Re I		10	2361.09 Ta I	
6	2340.94 Ta II		1.4	2352.47 Rh I		5	2361.23 Tm III	
5	2341.37 W I		3.5	2352.61 Mo I		1.6	2361.53 Co II	
7	2341.59 Mo II		1.8	2352.62 Ir I		8	2361.92 Rh I	
6	2341.61 Ta II		6	2352.65 Au I		5	2362.06 Ni I	
2.5	2341.82 Er II		22	2352.85 Co I		10	2362.41 Os I	
7 h	2342.85 Ru II		10	2352.99 Os I		28	2362.77 Os I	
1.6	2343.13 W I		4	2353.02 Hf I		6	2362.78 Ta II	
24	2343.18 Ir I		30	2353.42 Co I, II		2.5	2362.88 Yb II	
8	2343.32 Hf II		6	2353.86 Ta II		48	2363.04 Ir I	
11	2343.49 Fe II		6 d	2353.95 Re I		26	2363.06 W I	
11	2343.61 Ir I			2354.08 Re I		5	2363.32 Ta II	
4	2343.64 Ta II		3.0	2354.02 Th II		6	2363.33 Os I	
11	2343.74 Os I		1.6	2354.20 Y I		30	2363.79 Co II	
5	2344.03 As I		9	2354.61 W I		5	2363.93 Tm III	
8	2344.26 Co II		190	2354.84 Sn I		1.8	2364.22 W II	
22	2344.78 Re I		10	2355.00 Ir I		24	2364.24 Ta II	
3.5	2345.28 Re I		3.5	2355.22 Mo I		3.5	2364.37 Mo I	
1.2	2345.41 Rh		4	2355.22 Ta II		3.0 h	2364.71 Cr I	
26	2345.54 Ni I		3.5	2355.28 Os II		8	2364.83 Fe II	
7	2345.75 Os I		3.5	2355.42 Mo II		15	2365.07 Co I	
8	2346.16 Co I		9	2355.48 Co I		6	2365.32 Re I	
3.0	2346.42 Ta II		6	2356.05 Ta II		3.5	2365.45 W I	
4.0	2346.63 Ni I		7	2356.50 Re I		3.5	2365.85 W I	
3.5	2347.06 Re I		3.0	2356.75 Th II		36	2365.90 Re I	
11	2347.38 Os I		5	2356.90 Ta II		2.0	2365.95 Tm II	
12	2347.39 Co II		5	2356.91 Dy II		4	2365.98 Hf II	
11	2347.44 Hf II		7	2356.92 Os I		1.6	2366.04 Th II	
9	2347.52 Ni I		12	2357.05 Tm III		2.5	2366.09 Mo II	
6	2347.58 Ba II		10	2357.10 Pt I		3.5	2366.18 W I	
1.8	2347.97 W I		7	2357.25 Os I		3.0	2366.95 W I	
4	2348.10 Fe II		9	2357.30 Ta I		4	2366.98 Th II	
4	2348.30 Fe II		4	2357.53 Ir II		18	2367.06 Al I	
300	2348.61 Be I		2.0	2357.90 Sn I		7	2367.11 Tm II	
1.8	2349.26 W II		7	2357.91 Ru II		2.0	2367.24 Ta II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
8	2367.25	Y III	11	2375.07	Re I	12	2381.62	Ir I
16	2367.35	Os II	4	2375.07	Th II	3.0	2381.75	Co II
18	2367.68	Re I	6	2375.09	Ir II	1.6	2381.95	Dy
5	2367.68	W I	3.0	2375.18	Co II	60	2382.04	Fe II
7	2368.04	Ir II	3.0	2375.19	Fe II	7	2382.46	Os I
1.8	2368.05	Th II	12	2375.27	Ru I	10	2382.89	Rh I
7	2368.28	Pt I	4	2375.63	Ru II	8	2382.99	W I
3.0	2368.34	Rh I	5	2375.82	Re I	5	2383.17	Ir I
6	2368.53	Re II	3.0	2375.91	Ta I	4	2383.24	Fe II
4	2368.60	Fe II	3.5	2376.07	W I	55	2383.25	Te I
10	2369.24	Os I	13	2376.40	Nb II	4	2383.28	Er II
17	2369.27	Re I	1.8	2376.56	W I	6	2383.33	Cr I
6	2369.32	Ta II	100	2377.03	Os I	8	2383.40	Rh
20	2369.67	As I	1.8	2377.03	W I	36	2383.46	Co II
6	2369.68	Co I	4	2377.22	Co I	7	2383.46	Re I
2.0	2369.89	Cu II	5	2377.28	Ir I	9	2383.52	Mo I
8	2370.17	Ru I	3.5	2377.33	Re I	6	2383.64	Pt I
4	2370.51	Co I	10	2377.61	Os I	4	2383.64	Sb I
17	2370.70	Os I	3.5	2377.83	Er II	8	2383.68	Tm II
7	2370.76	Re II	9	2377.84	Th II	8	2383.72	Ta II
12	2370.76	Ta II	5	2377.98	Ir I	2.0	2383.79	Ir I
16	2370.77	As I	3.5	2378.14	Os I	2.5	2384.00	V II
3.5	2370.88	W I	7	2378.31	Ta II	1.8	2384.17	Zr I
17	2371.18	Os I	1.8	2378.41	Al I	11	2384.28	Ta II
1.8	2371.32	Ga I	2.5	2378.53	Re II	2.5	2384.28	V I
1.2	2371.39	W I	38	2378.62	Co II	3.0	2384.36	Th II
3.0 h	2371.44	Co I	3.5	2378.74	Os I	3.0	2384.39	Fe II
7	2371.52	Re I	9	2379.14	Ge I	1.6	2384.52	Ti I
13	2371.58	Ta I, II	7	2379.28	Fe II	10	2384.62	Os I
6	2371.86	Co I	11	2379.38	Ir I	1.4	2384.65	Rh I
7	2372.27	Mo I	40	2379.38	La III	26	2384.82	W I
70	2372.77	Ir I	34	2379.39	Os I	28	2384.86	Co I
3.0	2372.80	Ta II	7	2379.64	Os I	2.5	2385.24	Y
1.6	2372.83	Co I	40 h	2379.69	Tl I	6	2385.73	Ta I
36	2373.13	Al I	14	2379.77	Re I	70	2385.76	Te I
7	2373.36	Al I	7	2379.84	Os	10	2386.14	Rh
2.5	2373.38	Co I	7	2380.22	Re I	3.5	2386.17	W I
5	2373.48	Re II	13	2380.30	Hf II	20	2386.36	Co II
4	2373.67	Sb I	6	2380.41	Mo I	5	2386.58	Er II
11	2373.73	Fe II	28	2380.48	Co I	3.0	2386.58	Ir II
1.4	2373.83	Y	9	2380.72	Sn I	8	2386.58	Ni I
6	2373.84	Th II	7	2380.76	Fe II	2.0	2386.81	Pt I
4	2373.94	Ta II	3.0	2380.81	Ti I	30	2386.89	Ir I
1.8	2374.14	W I	3.5	2380.82	Os I	7	2386.90	Re II
3.0	2374.33	Os I	2.5	2380.89	Re I	4	2386.96	V I
1.8	2374.42	Zr I	5	2381.00	Hf II	70	2387.06	Ta II
18	2374.46	W I	20	2381.13	Ta II	10	2387.09	Nb II
3.5	2374.51	Os I	7	2381.14	Re I	6	2387.17	Er II
3.0	2374.76	W I	18	2381.18	As I	70	2387.29	Os I
3.5	2375.06	Os II	11	2381.52	Ta II	3.5	2387.36	Dy II

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
3.0	2387.46	Co I	48	2395.88	Os I	50	2402.72	Ru II
3.5	2387.46	Re I	2.0	2396.17	Pt I	3.5	2403.04	Re II
13	2387.52	Nb II	4	2396.30	Ta I	12	2403.09	Pt I
6	2387.75	Au I	6	2396.38	Er III	10	2403.54	Os I
1.8	2388.01	Zr I	6	2396.71	Ru II	10	2403.61	Mo II
3.0	2388.14	Th II	10	2396.78	Os I	6	2403.68	Ta II
4	2388.27	Nb II	15	2396.79	Re I	16	2403.85	Os I
4	2388.37	Ta II	3.0 h	2397.03	Co I	10	2404.17	Co II
14	2388.57	Re I	34	2397.09	W II	5	2404.17	Th II
16	2388.63	Fe II	5	2397.30	Er II	3.5	2404.24	W II
1.8	2388.80	Pb I	9	2397.31	Re I	7	2404.34	Re I
70	2388.92	Co II	14	2397.39	Co II	2.0	2404.41	Er II
4	2388.92	V I	3.0	2397.61	Os I	4	2404.43	Fe II
6	2388.95	Tm II	26	2397.72	W I	5	2404.51	Th II
10	2389.07	W I	5	2397.78	V I	5	2404.56	Hf II
7	2389.11	Re I	26	2397.98	W I	6	2404.66	Mo II
8	2389.11	Ta II	1.4	2398.01	Yb II	60	2404.88	Fe II
7	2389.20	Mo II	5	2398.18	Os I	70	2405.06	Re I
1.8	2389.21	Zr I	5	2398.27	V I	5	2405.08	Os II
6	2389.53	Pt I	16	2398.48	Nb II	2.5	2405.26	W I
14	2389.54	Co II	4	2398.56	Ca I	6	2405.34	Nb II
2.0	2389.54	In I	3.5	2398.71	Re I	36	2405.42	Hf II
5	2390.37	W II	3.5	2398.89	Re I	14	2405.45	Os I
7	2390.43	Re I	3.0	2399.04	W I	1.8	2405.52	Zr I
60	2390.62	Ir I	5	2399.14	Lu II	85 d	2405.58	W I
12	2390.73	Yb II	6	2399.15	Ta I		2405.69	W I
5	2390.87	V I	20	2399.24	Fe II	36	2405.60	Re I
70	2391.18	Ir I	1.8	2399.60	Pb I	6	2405.85	Nb II
5	2391.26	V I	3.0	2399.92	Ta II	10	2405.86	Mo I
3.5	2391.28	Re I	5	2399.96	V I	10	2405.96	Os I
3.5	2391.37	Co I	2.5	2400.30	Er II	3.0	2406.27	Co I
4	2392.15	Dy	140	2400.63	Ta II	9	2406.44	Hf II
55	2392.19	Lu II	10 d	2400.72	Re I	8	2406.55	Ta I
10	2392.42	Ru I		2400.89	Re I	19	2406.66	Fe II
5	2392.60	Co II	9	2400.78	Hf II	16	2406.70	Re I
6	2392.90	V I	1.4	2400.84	Co I	10	2406.75	V I
5	2392.93	W II	11	2400.88	Bi I	140	2407.25	Co I
3.0	2393.11	Th II	48	2401.13	Os I	2.5	2407.57	Ta I
10	2393.18	Hf II	1.6	2401.29	W I	7	2407.59	Ir I
26	2393.36	Hf II	10	2401.68	Re I	7	2407.67	Co II
10	2393.65	Re I	2.5	2401.77	Ir I	4	2407.88	Rh I
90	2393.79	Pb I	4	2401.87	Pt I	9	2407.90	V I
40	2393.83	Hf II	36	2401.95	Pb I	10	2407.92	Ru II
5	2393.90	Co II	28 d	2402.06	Co I	16	2408.15	Sn I
15	2394.29	Os I		2402.17	Co I	1.2	2408.19	Rh I
14	2394.37	Re I	8	2402.13	Ta II	4	2408.23	Tm II
12	2394.52	Ni II	13	2402.23	Os I	8	2408.26	Ta II
13	2395.39	Os I	6	2402.29	Dy II	3.0	2408.39	Mo I
5	2395.47	W I	5	2402.44	W I	9	2408.62	Cr I
60	2395.62	Fe II	7	2402.60	Re I	19	2408.67	Os I

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
8	2408.75	Co II	16	2415.21	Ta II	9	2420.12	V I
32	2409.03	Tm II	140	2415.30	Co I	7	2420.18	Mo II
5	2409.03	W I	10	2415.32	Os	2.5	2420.18	Rh II
9	2409.37	Ir I	6	2415.33	Mo I	3.5	2420.20	W I
8	2410.01	Dy II	11	2415.33	V I	2.5	2420.21	Tm II
26	2410.14	Hf II	34	2415.68	W I	5	2420.28	Er II
9	2410.17	Ir I	4	2415.84	Rh II	3.5	2420.73	Co II
1.2	2410.25	Rh I	12	2415.86	Ir I	10	2420.82	Ru I
14	2410.37	Re I	4	2415.96	Hf II	3.5	2420.98	Rh II
6	2410.51	Co I	10	2416.14	Ni II	3.0	2421.01	W II
19	2410.52	Fe II	3.0	2416.23	W I	10	2421.03	Ta I
2.5	2410.53	Er II	7	2416.30	Re I	9	2421.06	V I
3.0	2410.63	W I	7	2416.44	Re I	3.0	2421.15	Os I
9	2410.73	Ir I	11	2416.75	V I	4	2421.23	Ni I
4	2410.89	Ru I	22	2416.89	Ta II	6	2421.30	Ti I
13	2410.98	Os I	4	2416.90	Co II	3.0	2421.36	Yb II
6	2410.99	Re I	19	2416.99	Nb II	10	2421.38	Re I
14	2411.07	Fe II	4	2417.05	Co I	9	2421.64	Tm II
2.5	2411.30	Th II	5	2417.33	Ta II	260	2421.70	Sn I
3.5	2411.54	W II	8	2417.35	V I	17	2421.73	Re I
140	2411.62	Co I	85	2417.37	Ge I	11	2421.85	Ta II
8	2411.73	Pb I	28	2417.65	Co II	5	2421.86	Os
5	2411.90	Os	7	2417.66	Re I	17	2421.88	Re I
7	2412.44	Tm II	26	2417.69	Hf II	5	2421.94	Os
17	2412.46	Nb II	16	2417.86	Ta II	9	2421.98	V I
2.5 d	2412.53	Ta II	7	2417.96	Mo II	4	2422.13	Sb I
	2412.67	Ta I	32	2417.99	Os I	38	2422.20	Y II
8	2412.69	V I	7	2418.06	Pt I	8	2422.28	W I
42	2412.76	Co I	22	2418.11	Ir I	6	2422.56	Co I
3.5	2412.84	Mo II	3.5	2418.20	Re II	2.5	2422.66	W I
10	2413.01	Mo II	5	2418.35	Os I	6	2422.75	Dy II
6	2413.03	V I	4	2418.36	Ti I	4	2422.92	Ru I
10	2413.18	Ag II	32	2418.53	Os I	3.0	2423.00	Th II
3.0	2413.19	Co I	3.0	2418.64	Rh	13	2423.07	Os II
10	2413.22	Re I	18	2418.69	Nb II	2.0	2423.28	Tm II
15	2413.31	Fe II	8	2418.70	Ga I	4	2423.33	Ni I
17	2413.31	Ir I	11	2418.77	Ta II	4	2423.38	V I
7	2413.33	Hf II	6	2419.01	Mo II	13	2423.48	Ta II
6	2413.41	Th II	20	2419.12	Co I	3.5	2423.50	Re I
3.0	2413.58	Co I	4	2419.21	Lu II	3.5	2423.62	Co II
1.6	2413.93	Y II	12	2419.31	Ni I	4	2423.66	Ni I
17	2414.04	W I	3.0	2419.34	W II	6	2423.68	Th II
14	2414.06	Co II	5	2419.37	Tm II	3.0	2423.70	U
5	2414.10	Os I	10	2419.40	Re I	3.5	2423.84	Re II
8	2414.32	Ta I	3.0	2419.41	Zr II	5	2423.94	Rh
140	2414.46	Co I	6	2419.57	U	7	2424.00	Mo II
16	2414.52	Os I	3.0	2419.63	Os	5	2424.02	Os II
7	2414.59	Re I	2.5	2419.75	Rh I	4	2424.03	Ni I
16	2414.68	Y III	70	2419.81	Re I	4	2424.14	Fe II
4	2414.82	Ru II	6	2420.02	Os II	3.0	2424.19	Os

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70	2424.22 W I		3.5	2429.23 Co I		10	2435.51 Os I	
8	2424.24 Ti I		14	2429.39 W II		12	2435.52 V I	
5	2424.32 Ir I		420	2429.49 Sn I		10	2435.65 Os I	
32	2424.56 Os I		14	2429.52 Rh I		25	2435.83 Co I	
5	2424.66 Ir I		4	2429.60 Ru I		6	2435.95 Nb II	
8	2424.89 Ir I		7	2429.65 Re I		7	2435.96 Mo II	
130	2424.93 Co I		3.0	2429.67 Os I		160	2435.96 W I	
95	2424.97 Os I		28	2429.71 Ta II		7	2436.05 Re I	
14	2424.99 Ir I		13	2429.84 W I		4	2436.19 Tm II	
5	2425.23 Er II		3.0	2430.07 Fe II		2.5	2436.26 W I	
3.5	2425.38 Re I		3.5	2430.26 Lu II		5	2436.33 Nb I	
2.0	2425.59 Co I		7	2430.43 Mo I		3.5	2436.42 Ir I	
11	2425.66 Ir I		10	2430.44 W I		2.0	2436.51 Os I	
10	2425.91 Ta II		3.0	2430.75 Tm II		11	2436.51 Ta II	
10	2425.98 Hf II		14	2431.06 Ta II		22	2436.62 W I	
16 d	2425.98 W I		50	2431.08 W I		100	2436.66 Co I	
	2426.07 W I		2.0	2431.15 Th II		15	2436.69 Pt I	
40	2426.16 Tm II		26	2431.19 Os I		2.5	2436.98 Co II	
4	2426.19 Os I		22	2431.24 Ir I		9	2437.07 Ta I	
6	2426.35 Sb I		34	2431.54 Re I		1.2	2437.08 Rh I	
6	2426.53 Ir II		26	2431.61 Os I		9	2437.23 As I	
6	2426.64 Re I		5	2431.66 Ta I		7	2437.42 Nb II	
2.0	2426.78 Ir I		2.5	2431.85 Rh II		3.5	2437.54 Th II	
16	2426.81 Os I		55	2431.94 Ir I		6	2437.66 Tm II	
5	2427.00 Co I		8	2432.02 V I		8	2437.67 Ta I	
4	2427.11 Rh II		28	2432.18 Re I		5	2437.73 Os	
7	2427.28 Er II		120	2432.21 Co I		8	2437.79 Ag II	
10	2427.29 W I		7	2432.36 Ir I		8	2437.80 Rh	
4	2427.45 U		2.5	2432.4 U		6	2437.89 Ni II	
15	2427.49 W II		4	2432.58 Ir I		2.5	2437.96 W I	
20	2427.61 Ir I		2.5	2432.66 Rh I		1.6	2438.01 La II	
28	2427.64 Ta I		10	2432.70 Re I		14	2438.46 Re I	
8	2427.68 Rh I		40	2432.70 Ta II		7	2438.62 Sc	
5	2427.90 Os II		4	2432.85 Th II		10	2438.64 Ta II	
200	2427.95 Au I		6	2432.93 Ru I		90	2439.05 Co I	
5	2428.00 Ta II		3.0	2433.22 Ti I		10	2439.06 Re I	
6	2428.04 Pt I		12	2433.28 Re I		6	2439.10 V I	
1.2	2428.10 Sr I		3.0	2433.47 Sn I		4	2439.45 Er II	
4	2428.20 Pt I		12	2433.57 Hf II		7	2439.74 Fe I	
3.0	2428.23 Ti I		11	2433.59 Ta II		13	2439.82 Dy II	
11	2428.28 V I		7	2433.61 Re I		18	2439.91 Ta I	
3.5	2428.29 Co II		12	2433.80 Nb II		60	2440.06 Pt I	
5	2428.42 Tm II		55	2433.98 W I		5	2440.11 Fe I	
160	2428.58 Re I		1.6	2434.10 Ti I		3.0	2440.21 Ti II	
13	2428.60 Co I		4	2434.74 Hf II		7	2440.28 Mo II	
1.6 h	2428.63 Pb I		5	2434.74 Tm II		24	2440.34 Rh I	
3.5	2428.75 Hf I		5	2435.01 W II		5	2440.41 Re I	
10	2428.99 Hf II		26	2435.09 Co I		5	2440.58 Re I	
2.0	2429.10 Pt I		11	2435.14 Ir I		3.0	2440.68 Os I	
4	2429.16 Sc		26	2435.16 Si I		9	2440.69 Tm II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
6	2440.98 Ti I		28	2448.39 W I		5	2455.24 Sn I	
20	2441.05 Co I		5	2448.84 Rh I		80	2455.50 W I	
25 c	2441.47 Re I		4	2448.93 U		20	2455.53 Ru II	
6	2441.64 Cu I		2.0	2449.02 Ir I		65	2455.61 Ir I	
4	2441.89 V I		7	2449.03 Re II		2.0	2455.68 U	
6	2442.00 Os I		4	2449.04 Rh I		2.5	2455.70 Rh II	
6	2442.14 Nb II		2.5	2449.16 Co II		16	2455.83 Re II	
12	2442.39 Ta I		16	2449.44 Hf II		11	2455.87 Ir I	
17	2442.51 Re I		8	2449.44 Ta II		5	2455.99 Re I	
10	2442.57 Fe I		7	2449.52 Re II		10	2456.24 Co I	
5	2442.68 Nb II		50	2449.71 Re I		8	2456.30 Th II	
6	2442.97 W I		10	2449.85 Zr II		16	2456.44 Ru II	
2.5	2443.33 W I		3.0	2449.88 Os		44	2456.46 Os I	
10	2443.62 W I		4	2450.00 Co II		36	2456.53 As I	
36	2443.84 Pb I		75	2450.07 Ga I		80	2456.53 W I	
5	2443.87 Fe I		2.5	2450.44 Ti II		40	2456.57 Ru II	
3.0	2443.96 Th II		4	2450.44 U		2.0	2456.86 Th II	
55	2444.06 W I		6	2450.56 Rh		10	2457.03 Ir I	
7	2444.09 Re I		3.5	2450.58 Ru I		6	2457.16 Os I	
10	2444.13 Ta II		75	2450.74 Os I		10	2457.23 Ir I	
4 h	2444.27 Rh		2.5	2450.78 Th II		1.4	2457.44 Zr II	
2.5	2444.46 Th II		7	2450.89 Re I		18	2457.60 Fe I	
4	2444.51 Fe II		6	2450.97 Pt I		4	2458.03 Er II	
9	2444.67 Ta II		6	2451.19 Os I		10	2458.09 Nb II	
20	2444.94 Re I		9	2451.20 Tm II		9	2458.57 Tm II	
4	2444.99 Hf I		28	2451.34 W I		7 h	2458.62 Ru I	
11	2445.34 Ir I		80	2451.48 W II		10	2458.68 Ta I	
14	2445.46 Tm II		44	2451.73 Os I		6	2458.76 Os	
18	2445.51 Sb I		12	2451.87 Nb II		7	2458.78 Fe II	
5	2445.53 Ta II		90	2452.00 W I		5	2458.90 Rh II	
3.0	2445.56 Fe II		4	2452.30 Hf II		2.5	2459.01 Th II	
6	2445.88 Os I		44	2452.81 Ir I		110	2459.30 W I	
4	2445.94 Tm II		7	2453.14 Re I		10	2459.64 Lu II	
28	2446.02 Os I		5	2453.29 Os I		4	2459.75 Er II	
65	2446.19 Pb I		12	2453.34 Hf II		9	2459.84 Os I	
13	2446.39 Er II		6	2453.47 Fe I		6	2460.00 Dy II	
15	2446.39 W II		44	2453.90 Os I		6	2460.08 In I	
50	2446.98 Re I		12	2453.95 Nb II		28	2460.16 W I	
10	2447.17 Ta I		6	2453.99 Ni I		1.2	2460.21 Co I	
42	2447.25 Hf II		4	2454.12 Ir I		7	2460.24 Re I	
3.5	2447.25 Yb II		8	2454.21 Ta I		4	2460.24 Yb II	
7	2447.40 Tm II		3.5	2454.37 U		50	2460.49 Hf II	
3.5	2447.45 Ru I		10	2454.48 Ta I		10	2460.55 Ta I	
2.0	2447.49 Ir I		5	2454.70 Ta II		6	2460.61 Y II	
7	2447.71 Fe I		44	2454.71 W I		4	2460.71 Er II	
11	2447.76 Ir I		4	2454.90 Tm II		20	2460.81 Co I	
65	2447.91 Pd I		9	2454.91 Os II		7	2461.04 Rh II	
3.0	2447.93 Ag II		7	2454.92 Ru I		8 d	2461.06 Ta II	
10	2448.20 Re I		65	2454.97 W I		32	2461.20 Re I	
9	2448.23 Ir I		5	2455.16 Dy II		150	2461.42 Os I	

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6	2461.48	Ce	44	2467.44	Pt I	12	2473.31	Ta II
20	2461.57	W I	16	2467.57	Re II	3.0	2473.39	Ce
5	2461.81	Mo II	12	2467.69	Co I	10 d	2473.69	W I
65 c	2461.84	Re II	3.5	2467.73	Fe I		2473.82	W I
2.5	2462.12	Co I	10	2467.85	Re II	12	2473.72	Re II
11	2462.18	Fe I	16	2467.97	Hf II	5	2473.90	Co I
4	2462.36	Ir I	3.0 h	2468.02	In I	11	2473.92	Hf II
7	2462.54	Re I	9	2468.09	Os I	3.5	2474.04	Ru I
70	2462.64	Fe I	5	2468.15	Th II	120	2474.15	W I
50	2462.79	W I	7	2468.22	Gd II	1.8	2474.57	Sb I
12	2462.89	Nb I	3.0	2468.26	U	60	2474.62	Ta I
6	2462.94	Ru I	5	2468.41	Ta II	13	2474.73	Re I
9	2462.97	Ce	6	2468.78	Mo II	24	2474.78	Os I
4	2463.03	Ir I	14	2468.88	Fe I	22	2474.81	Fe I
9	2463.31	Re I	9	2468.90	Os II	160	2475.12	Ir I
2.5	2463.61	Rh	10	2469.08	Nb I	13	2475.17	Re II
3.5	2463.73	Fe I	24	2469.18	Hf II	12	2475.33	Ta I
3.5	2463.78	Co I	6	2469.27	Lu II	12	2475.41	Ru I
16	2463.82	Ta II	12 c	2469.36	Re II	1.2	2475.64	Rh II
8	2463.97	Hf II	4	2470.04	Mo II	9	2475.69	Os I
9	2464.00	Os	5 h	2470.05	Re I	6	2476.28	Re I
48	2464.19	Hf II	20	2470.28	Co I	130	2476.38	Pb I
3.5	2464.20	Co II	6	2470.39	Rh I	100	2476.42	Pd I
28	2464.31	W I	4	2470.59	Th II	20	2476.64	Co I
4	2464.36	Ce	10	2470.61	Re II	20	2476.67	Ta II
65	2464.49	Yb I	5	2470.64	U	75	2476.84	Os I
15	2464.50	Os I	8	2470.80	W II	6	2476.87	Ni I
2.0	2464.62	Co I	5	2470.82	Os	11	2476.88	Ru I
6	2464.63	Er III	38	2470.90	Ta II	3.0	2476.95	Th II
9	2464.70	Ru I	3.5	2471.01	Pt I	9	2476.96	Tm II
4	2464.90	Ir I	6	2471.05	Re II	2.5	2477.18	U
9	2464.94	Tm II	8	2471.21	W I	20	2477.38	Nb II
10	2465.06	Hf II	2.0	2471.36	Tm II	6	2477.43	Re II
6	2465.09	Ir I	12	2471.38	Ta I	1.2	2477.54	Rh
10	2465.13	Re I	5	2471.41	Dy II	9	2477.57	Mo II
14	2465.15	Fe I	7	2471.47	Rh I	2.0	2477.59	Er II
6	2465.16	Os	4	2471.58	Gd II	30	2477.80	W II
10	2465.20	W I	6	2471.90	La II	10	2478.11	Ir I
8	2465.26	Ta I	19 h	2471.97	Mo I	15	2478.22	Ta I
4	2465.67	Hf I	11	2472.06	Ni I	12	2478.29	Nb II
8	2466.13	Th II	12	2472.13	Ta I	4	2478.32	Er II
24	2466.52	W II	24	2472.28	Os I	18	2478.32	Sb I
6	2466.68	Mo II	14	2472.34	Fe I	10	2478.57	C I
6	2466.73	Nb I	3.0	2472.44	La II	30	2478.93	Ru II
140	2466.85	W I	2.5	2472.51	Rh	16	2479.02	Re I
6	2466.97	Mo II	50	2472.51	W I	9	2479.05	V II
13	2466.99	Ta II	90	2472.88	Fe I	2.0	2479.16	Ir I
3.5	2467.26	Er II		2472.91	Fe I	7	2479.48	Fe I
42	2467.30	Ir I	10	2473.09	Rh I	6	2479.52	V II
13	2467.37	Ta II	15	2473.13	Ta I	8	2479.58	Ta II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
100	2479.78	Fe I	1.2	2485.36	Co II	8	2490.84	W I
3.0	2479.85	La II	5	2485.38	Ir I	4	2490.93	Tm II
12	2479.94	Nb II	2.5	2485.67	Gd II	1.2	2490.93	U
85	2480.13	Tm II	32	2485.81	Re I	24	2491.02	Os I
90	2480.13	W I	44	2486.24	Os II	140	2491.16	Fe I
3.5	2480.44	Sb I	13	2486.30	W I	6	2491.56	Er II
4	2480.65	W I	3.0	2486.37	Ce	28	2491.59	Tm II
2.5	2480.71	Os I	9	2486.37	Fe I	24	2491.69	Os I
15	2480.82	Re I	2.0	2486.37	Ir I	2.0	2491.78	Ru I
6	2480.92	Dy II	4	2486.44	Co II	36	2492.15	Cu I
40	2480.95	W I	3.0	2486.53	Pd II	4	2492.27	Er
3.0	2481.11	Ru II	7	2486.69	Fe I	2.5	2492.30	Rh I
17	2481.15	Tm II	12	2486.70	Ta I	30	2492.42	Os I
100	2481.18	Ir I	2.0	2486.75	Ir I	16	2492.84	Re I
6	2481.44	Hf II	10	2486.78	Re I	44	2492.91	As I
160	2481.44	W I	5	2486.97	Re I	8	2492.93	W II
16 h	2481.72	Lu II	9	2487.06	Fe I	30	2493.08	Ir I
15	2481.79	Os	6	2487.16	Hf I	18	2493.18	Fe II
9 h	2481.81	Mo I	100	2487.17	Pt I		2493.26	Fe II
12	2481.86	Ta II	5	2487.29	Zr II	6	2493.27	Er II
2.0	2482.04	Rh	80	2487.33	Re I	4	2493.29	Gd II
10	2482.10	Ta I	3.5	2487.37	Fe I	7	2493.39	W I
50 d	2482.10	W I	5	2487.46	Gd II	15	2493.62	Os
	2482.21	W I	4	2487.47	Er II	7	2493.69	Ru II
6	2482.31	V II	12	2487.47	Rh	5	2493.83	Os I
30	2482.43	Os I	40	2487.49	W I	3.0	2493.93	Co I
8	2482.57	Mo II	14	2487.52	Tm II	9	2494.02	Ru I
10	2482.58	Ta II	6	2487.59	La II	5	2494.48	Ru II
6	2482.65	Hf I	260	2488.15	Fe I	6 h	2494.51	Rh
280	2483.27	Fe I	380	2488.55	Os I	70	2494.56	Be I
4	2483.33	Rh I	60	2488.70	Ta II		2494.58	Be I
110	2483.39	Sn I	8	2488.72	Gd II	3.0	2494.61	Th II
8	2483.46	Ta II	2.5	2488.74	Pt II	100	2494.73	Be I
18	2483.61	Co I	28	2488.77	W II	5	2494.73	Co I
6	2483.88	Nb II	12	2488.91	W I	12	2495.26	Re I
100	2483.92	Re I	8	2488.92	Pd II	65	2495.26	W I
3.0	2484.01	U	6	2489.04	Os I	6	2495.35	Th II
3.0	2484.04	Os I	2.0	2489.20	Ir I	16	2495.55	Co I
10	2484.04	Ta II	40	2489.23	W II	9	2495.69	Ru II
90	2484.19	Fe I	6	2489.62	Th II	110	2495.70	Sn I
3.0	2484.40	W II	7	2489.72	W I	16	2495.82	Pt I
8	2484.72	Ta II	180	2489.75	Fe I	30	2496.04	Re I
60	2484.74	W I	3.5	2489.91	Ru I	3.0	2496.24	Mo II
5	2484.75	Mo II	20	2490.12	Pt I	5	2496.24	Ta I
2.0	2484.87	Yb II	6	2490.16	Re II	10	2496.27	Ir I
50	2484.95	Ta I	2.5	2490.42	Y I	17	2496.31	Cr I
1.2	2485.05	Th II	50	2490.46	Ta I	2.5	2496.35	Gd II
3.5	2485.17	Er II	9	2490.62	Dy II	6	2496.45	Os
5 h	2485.31	Mo I	180	2490.64	Fe I	3.0	2496.48	Zr II
5	2485.32	Os	8	2490.77	Rh II	14	2496.53	Fe I

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
7	2496.56 Ru I		10	2500.86 U		3.0	2505.10 Rh II	
5	2496.61 Os		8	2500.91 Os I		10	2505.32 Ta II	
7	2496.64 Ta I		90	2501.13 Fe I		4	2505.38 W I	
24	2496.64 W II		8	2501.48 Ru I		6	2505.43 Re I	
3.0	2496.70 Re I		18	2501.61 V I		4	2505.46 Yb II	
16	2496.71 Co I		3.5	2501.70 Fe I		3.5	2505.60 Th II	
240	2496.78 B I		30	2501.72 Re I		10	2505.65 W I	
5	2496.97 W I		16 d	2501.78 W I		12	2505.67 Rh I	
32	2496.99 Hf II			2501.90 W II		6	2505.74 Ir I	
10	2497.48 W II		5	2501.84 Os I		3.0	2505.89 Tm II	
1.8	2497.56 Th II		6	2501.89 Ru I		5	2505.93 Pt I	
480	2497.73 B I		14	2501.98 Ta II		22	2505.94 Re I	
5	2497.77 Ta II		10	2502.00 Yb II		28	2506.03 W I	
90	2497.96 Ge I		1.2	2502.28 Co I		9	2506.22 V II	
16	2498.22 Re I		28	2502.29 Os I		7	2506.38 Os	
11	2498.28 Mo II		46	2502.35 Re II		3.0	2506.45 Tm II	
9	2498.33 Ta II		10	2502.46 Rh I		24	2506.46 Co II	
5	2498.40 Th II		5	2502.49 Nb II		4	2506.60 Ir I	
220	2498.41 Os I		11	2502.53 Cr I		7	2506.66 Os	
15	2498.42 Ru II		12	2502.63 Ir I		15	2506.88 Co I	
24	2498.50 Pt I		8	2502.66 Hf I		170	2506.90 Si I	
15	2498.57 Ru II		6	2502.69 Tm II		20	2506.90 V I	
3.5	2498.78 Pd II		8	2502.84 Mo II		28	2507.01 Ru II	
1.6	2498.83 U		3.0	2502.87 Th II		14	2507.14 Tm II	
9	2498.86 Re I		11	2502.91 Ho II		3.0	2507.18 Os II	
5	2498.86 Th II		200	2502.98 Ir I		12	2507.40 Re I	
10	2498.89 Fe I, II		10	2503.01 Ta II		60	2507.45 Ta I	
4	2498.98 Ce		8	2503.02 V II		6	2507.63 Ir I	
1.2	2499.02 Rh		1.4	2503.04 W I		6	2507.64 Er II	
3.0	2499.04 Gd II		3.0	2503.16 Os		12	2507.68 Co I	
10	2499.20 Tm II		10	2503.30 V I		32	2507.78 V I	
2.0	2499.39 Eu II		8	2503.48 Er II		10	2507.90 Fe I	
10	2499.44 W I		8	2503.67 Os		5	2507.91 Th II	
11	2499.52 Tm II		1.2	2503.84 Rh II		2.5	2508.00 W II	
9	2499.67 Er I		1.2	2503.9 U		1.6	2508.04 Yb II	
14	2499.69 W II		4	2503.96 W I		5	2508.11 Cr I	
9	2499.78 Ru I		9	2504.28 Th II		14	2508.27 Ru I	
28	2499.92 Os I		24	2504.29 Rh		4	2508.35 Ir I	
4	2500.11 W II		19	2504.31 Cr I		10	2508.44 W I	
130 h	2500.17 Ga I		8	2504.37 Ir I		12	2508.50 Pt I	
4	2500.27 Ir I		42	2504.39 Os I		5	2508.53 Ho II	
6	2500.31 Re I		60	2504.45 Ta I		14	2508.61 Os I	
5	2500.44 Mo II		22	2504.51 Os I		6 h	2508.67 Mo I	
1.2 h	2500.50 Co I		24	2504.52 Co I		20	2508.74 W I	
11	2500.57 Re I		7	2504.53 W I		10	2508.92 Ta II	
3.0	2500.58 Rh		2.5	2504.54 Ti I		6	2508.98 Cr I	
12	2500.70 Ga I		19	2504.60 Re II		150 c	2508.99 Re I	
8	2500.72 Os		20	2504.65 Nb I		12	2509.07 Ru I	
8	2500.74 Hf II		70	2504.70 W I		140	2509.08 Tm II	
3.5	2500.84 Ru I		7	2504.74 Tm III		6	2509.56 Mo I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
28	2509.70	Rh I	5	2513.94	Er II	17	2519.29	Os I
8	2509.71	Ir I	5	2514.07	Pt I	40	2519.52	Cr I
6	2509.71	Os II	160	2514.32	Si I	32	2519.62	V I
14	2509.94	Os I	6 c	2514.51	Re I	6	2519.63	Fe I
2.5	2509.96	Th II	10	2514.64	V II	10	2519.78	Ta I
26	2510.16	W I	5	2514.77	U	28	2519.79	Os I
5	2510.32	Dy II	6	2515.03	Pt I	11	2519.80	Tm III
8	2510.47	W II	55	2515.04	Os I	12	2519.82	Co II
3.0	2510.54	Sb I	8	2515.08	Mo II	10	2519.88	W I
4	2510.66	Rh II	9	2515.15	V I	3.5	2519.95	Ru I
10	2510.71	Ta II	7	2515.28	Ru I	46	2520.01	Re I
90	2510.83	Fe I	6	2515.36	Ir I	32	2520.45	W I
20	2511.00	Nb II	5	2515.47	Re I	7	2520.51	Nb I
90	2511.02	Co I	15	2515.48	Hf II	10	2520.53	Rh II
24	2511.03	Rh	24	2515.58	Pt I	15	2520.54	Ti I
3.5	2511.56	Ru I	3	2515.66	Mo I	7	2520.66	Th II
24	2511.65	V I	2.5	2515.69	Bi I	22	2520.87	Tm II
5 d	2511.69	Ta II	16	2515.75	Rh I		2520.94	Tm II
7	2511.76	Fe II	360	2516.11	Si I	2.5	2520.95	Er II
6	2511.80	Mo II	10	2516.12	Re I	6	2520.98	W I
5	2511.82	Tm II	2.5	2516.36	Yb II	80	2521.32	W I
8	2511.94	Ir I	2.5	2516.42	Th II	180	2521.36	Co I
24	2511.95	V I	9	2516.58	W I	10	2521.37	In I
20	2512.05	Yb II	100	2516.88	Hf II	20	2521.40	Nb II
7	2512.36	Fe I	11	2516.92	Cr I	8	2521.49	Hf II
1.2	2512.40	Co II	4	2517.08	Re I	44	2521.50	Re I
6	2512.55	Re I	24	2517.14	V I	6	2521.61	Ru I
8	2512.58	Ir II	12	2517.32	Ru II	28	2522.04	W II
24	2512.65	Ta I	8	2517.43	Ti II	28	2522.16	Tm II
65	2512.69	Hf II	6 h	2517.46	Mo I	7	2522.42	Yb II
12	2512.81	Ru I	9	2517.60	Dy II	280	2522.85	Fe I
55	2512.87	Os I	3.0	2517.61	Os I	80	2523.41	W I
4	2512.90	Co I	6	2517.62	Ru I	6	2523.59	W I
3.0	2512.93	W	9	2517.66	Fe I	14	2523.66	Fe I
65	2513.03	Hf II	3.0	2517.83	Mo I	15	2523.92	Sn I
10	2513.10	Ta II	8	2517.86	Hf I	20	2524.09	Tm II
5	2513.12	Co I	36	2517.87	Co I	240	2524.11	Si I
200	2513.25	Os I	42	2517.92	Os I	50	2524.29	Fe I
6	2513.30	Ce	70	2518.10	Fe I	14	2524.30	Pt I
12	2513.32	Ru II	6	2518.14	W II	7	2524.49	Bi I
4	2513.33	Mo I	55	2518.44	Os I	8	2524.64	Ti II
6	2513.36	Rh	2.5	2518.46	Tm II	6	2524.79	Os I
7	2513.55	Ho II	3.0	2518.50	W I	12 h	2524.81	Mo I
9	2513.57	Dy II	8	2518.51	Ce	8	2524.81	W I
4	2513.62	Cr I	8	2518.71	Cr I	2.0	2524.88	Ir II
10	2513.71	Ir I	6	2518.73	Ho II	12	2524.96	Co II
10 d	2513.77	Tm I	5	2518.97	U	5	2524.99	Nb I
	2513.85	Tm II	3.0	2519.02	Ce II	6	2525.02	Fe I
7	2513.88	Ta II	4	2519.04	Ti I	8	2525.05	Ir I
14	2513.93	W I	120	2519.21	Si I	3.0	2525.17	Ru I

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7	2525.39	Fe II	6	2530.64	Ru I	12	2534.97	Ta I
9	2525.55	Re I	7	2530.69	Fe I	5	2534.99	Er II
38	2525.60	Ti II	12	2530.70	Te I	9	2535.10	W I
14	2525.68	W I	10	2530.97	Nb II	2.5	2535.36	Co I
16	2525.81	Nb II	2.5	2530.99	W I	16	2535.59	Ru II
1.2	2525.93	Th II	38	2531.19	Hf II	70	2535.60	Fe I
1.0	2525.99	Rh I	5	2531.25	Nb II	60	2535.65	P I
14	2526.01	Os I	20	2531.25	Ti II	4	2535.87	Th II
14	2526.02	Ta II	5	2531.29	Ta I	14	2535.87	Ti II
2.5 d	2526.22	Th II	2.0	2531.43	Tm II	120	2535.96	Co I
	2526.34	Th II	1.0	2531.74	Rh I	36	2536.49	Co I
55	2526.22	V I	60	2532.12	Ta II	5	2536.49	Pt I
5	2526.30	Fe II	36	2532.18	Co I	1500	2536.52	Hg I
120 d	2526.35	Ta I	2.5	2532.20	Ir I	9	2536.71	Rh
	2526.45	Ta I	9	2532.31	Mo II	12	2536.82	Fe II
10	2526.42	W I	4	2532.43	Th II	9	2536.85	Mo I
2.0	2526.77	Ir I	17	2532.44	Os I	8	2536.86	Ho II
5	2526.81	Re I	12	2532.46	Zr II	28	2536.95	Lu II
6	2526.83	Os I	6	2532.52	Ir I	10	2537.02	Er II
8	2526.83	Ru I	4	2532.66	Rh	9	2537.04	Rh II
14	2527.03	Tm I	9	2532.97	Hf II	12	2537.17	Fe
11	2527.09	Os I	12	2533.00	Ta I	28	2537.22	Ir I
19	2527.12	Cr I	8	2533.06	Mn I	5	2537.30	U
9	2527.14	Mo II	48	2533.13	Ir I	22	2537.33	Hf II
12	2527.42	Tm II	4	2533.14	La II	9	2537.64	Yb II
140	2527.43	Fe I	70	2533.23	Ge I	8	2537.68	Ir I
44	2527.77	W I	3.0	2533.23	U	16	2537.94	Ta II
4	2527.86	Tm II	5	2533.24	Ru I	65	2538.00	Os II
28	2527.90	V II	12	2533.31	Re I	20	2538.10	Os I
3.0	2527.98	Ti I	1.0	2533.59	Rh	9	2538.43	U
2.5	2528.10	U	7	2533.63	Fe II	55	2538.46	Mo II
16	2528.47	V II	80	2533.63	W I	38	2538.67	Yb II
6	2528.51	Ba II	6	2533.80	Fe I	2.5	2538.73	U
200	2528.51	Si I	11	2533.80	Ho I	7	2538.81	Fe II
320	2528.52	Sb I	3.0	2533.98	W I	2.0	2538.88	Ir I
48	2528.62	Co II	22	2534.01	P I	7	2539.00	Fe II
20	2528.84	V II	4	2534.07	Rh	16	2539.20	Pt I
6	2528.88	Ru I	12	2534.10	Re II	7	2539.31	W I
120	2528.97	Co I	7	2534.16	Ta I	9	2539.33	Re I
50	2529.13	Fe I	10	2534.17	Os I	6	2539.44	Mo II
4	2529.41	Pt I	7	2534.34	Cr II	6	2539.65	Zr I
11	2529.50	Re I	6	2534.42	Fe II	2.5	2539.72	Rh
6	2529.55	Fe II	55	2534.46	Ir I	11	2539.73	Os I
20	2529.72	W I	5	2534.47	Ta I	14	2540.14	Os I
16	2529.83	Fe I	4	2534.52	V II	1.2	2540.28	Y
22	2529.85	Ti I	20	2534.62	Ti II	2.0	2540.40	Ir I
30	2530.13	Co I	5	2534.68	W I	14 h	2540.45	Mo I
32	2530.18	V I	30	2534.80	Re I	46	2540.51	Re I
6	2530.34	Mo II	5	2534.82	W II	16	2540.62	Nb II
4	2530.45	Cr I	3.0	2534.95	U	15	2540.74	Os I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
80	2540.98 Fe I		42	2545.22 Sc II		65	2549.61 Fe I	
5	2541.28 Ru I		5	2545.34 Th II		1.0	2549.99 Th	
2.5	2541.37 U		60	2545.34 W I		2.5	2550.02 Fe II	
16	2541.42 Nb II		30	2545.48 Re I		2.0	2550.04 Yb II	
5	2541.48 Ir I		24	2545.49 Ta II		13	2550.09 Re II	
6	2541.65 Os I		7	2545.54 Ir I		4	2550.10 W II	
8	2541.69 W I		5	2545.64 Cr I		1.0	2550.17 Y	
20	2541.92 Ti I		28	2545.70 Rh		80	2550.37 W I	
8	2541.94 Co II		3.0	2545.74 Th II		3.0	2550.51 Zr I	
28	2542.02 Ir I		80	2545.98 Fe I		15	2550.74 Zr II	
16	2542.10 Fe I		8	2545.98 V I		14 h	2550.85 Mo I	
15	2542.10 Zr II		38	2546.03 Ir I		14	2551.00 W I	
9 d	2542.23 Ta I		13	2546.17 Os I		46 d	2551.07 Ta I	
	2542.35 Ta II		240	2546.55 Sn I			2551.19 Ta I	
85	2542.51 Os I		13	2546.67 Ru I		6	2551.09 Fe I	
3.0	2542.65 Th II		1.2	2546.74 Co II		1.2	2551.24 Th II	
13	2542.66 Tm II		24	2546.80 Ta I		280	2551.35 W I	
42	2542.67 Mo II		3.0	2546.87 Lu II		20	2551.38 Nb II	
2.0	2542.80 Ir II		120	2547.14 W I		36	2551.40 Hf II	
6	2543.09 Ce		6	2547.20 Ir I		10	2551.40 Ir I	
7	2543.25 Ru II		11	2547.28 Er II		3.5	2551.51 Tm II	
8	2543.35 Mo I		1.4	2547.57 Y		14	2551.73 Ta II	
3.5	2543.38 Fe II		6	2547.69 Ir I		2.0	2551.77 Ce	
12	2543.44 W I		12	2547.70 Os I		3.0	2551.85 Hf II	
5	2543.45 Mn II		13	2547.90 Th II		3.0	2551.98 W I	
5	2543.61 Mo II		13	2548.10 Os I		24	2552.02 Re I	
9	2543.67 Re I		9	2548.14 Re I		10	2552.14 Yb II	
2.0	2543.68 Gd II		3.0	2548.14 Th II		5	2552.25 Pt I	
11	2543.80 Os I		3.5	2548.15 W I		8	2552.31 Dy II	
7	2543.83 Dy II		12	2548.20 Hf II		220	2552.37 Sc II	
5	2543.84 Re I		42	2548.22 Mo I		13	2552.49 Tm III	
16	2543.92 Fe I		18	2548.34 Co I		16	2552.65 V I	
380	2543.97 Ir I		3.5	2548.57 W I		8	2552.69 Yb II	
3.5	2544.02 Tm II		1.0	2548.60 Rh		3.0	2552.73 Re I	
3.0	2544.17 W I		5	2548.63 Nb II		40	2552.75 Tm II	
1.6	2544.19 Au I		14 d	2548.68 Ce		12	2552.96 V II	
9	2544.22 Re I		8	2548.69 V II		12	2553.00 Co I	
3.0	2544.22 Rh		2.5	2548.83 Os II		4	2553.06 Cr I	
30	2544.22 Ru I		12	2548.88 Re I		18	2553.16 W I	
90	2544.25 Co I		5	2549.09 W II		7	2553.18 Ta II	
5	2544.27 Ta I		14	2549.28 V II		38	2553.28 P I	
	2544.37 Ta II		12	2549.30 Co I		16	2553.37 Co I	
2.0	2544.36 U		5	2549.30 U		12 c	2553.59 Re II	
7	2544.71 Fe I		5	2549.37 Re I		5	2553.67 V II	
60 d	2544.74 Re I		14	2549.38 Ta I		46	2553.82 W I	
	2544.88 Re		1.8	2549.46 Pt I		6	2554.18 Re I	
70	2544.80 Nb II		30	2549.48 Ru I		9	2554.40 Ir I	
10	2544.86 Co I		3.0 d	2549.52 Lu I		26	2554.46 Os I	
6	2544.90 Er II		16	2549.54 Cr I		46	2554.62 Ta II	
5	2545.13 Dy II		60	2549.58 Ru I		30	2554.63 Re II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
1.2	2554.64 Sb I		2.0	2558.62 Rh		28	2563.61 Hf II	
1.0	2554.65 Th I		10	2558.88 Mo II		15	2563.65 Mn II	
2.5	2554.78 Eu II			2558.94 Mo I		14	2563.70 Ta I	
7	2554.86 V I		5	2558.90 V I		17	2563.86 Tm II	
42	2554.86 W II		14	2558.94 Nb I		11	2563.91 W II	
12	2554.91 Ta II		7	2559.02 Hf I		16	2564.04 Co II	
15	2554.93 P I		20	2559.08 Re I		15	2564.17 Eu II	
5	2554.93 Re I		2.5	2559.18 Eu II		44	2564.18 Ir I	
24	2555.05 Ta I		14	2559.19 Hf II		28	2564.19 Re I	
16	2555.07 Co I		12	2559.41 Co II		10 h	2564.23 V I	
60	2555.09 W II		120	2559.43 Ta I		11	2564.34 Mo II	
	2555.20 W I		3.0	2559.49 U		10	2564.37 Os I	
13	2555.11 Os I		6	2559.71 Re I		3.0	2564.58 Ru I	
1.8	2555.17 Th II		6	2559.88 Re I		15	2564.68 W I	
10	2555.27 Os I		30	2560.12 W I		4	2564.78 Er II	
10	2555.35 Ir I		110	2560.15 In I		15	2564.82 V I	
44	2555.36 Rh I		5	2560.19 Dy II		11	2565.17 Os I	
8	2555.42 Mo II		4	2560.19 Os		24	2565.41 Nb I	
10	2555.63 Nb II		170	2560.25 Sc II		26	2565.41 U	
13	2555.80 Os I		14	2560.26 Ru I		3.0	2565.56 Yb II	
42	2555.82 Sc II		4	2560.37 La II		44	2565.60 Th II	
2.5	2555.86 Ru I		4	2560.47 Os		5	2565.72 Os I	
8	2555.88 Ir I		18	2560.68 Ta I		4	2565.79 Rh I	
7	2555.99 Ti II		13	2560.69 Cr I		6	2565.84 Re I	
3.5	2556.00 Ru I		3.0	2560.75 W I		7	2565.98 Tm II	
9	2556.08 Os I		13	2560.83 Ru I		3.5	2566.04 Rh I	
16	2556.19 U II		0.7	2560.93 Th II		5	2566.25 Dy II	
4	2556.27 W I		12	2561.46 Re I		5	2566.26 Mo II	
2.5	2556.30 Ge I		9	2561.51 W I		50	2566.49 Os I	
4	2556.31 Ru I		60	2561.65 Tm II		3.0	2566.57 Re I	
3.0	2556.43 Zr I		2.5	2561.80 Lu II		6	2566.59 Ru I	
85	2556.51 Re I		7	2561.94 Th II		24	2566.59 Th II	
14	2556.51 Ta II		75	2561.96 W I		24	2566.88 Os I	
8	2556.57 Mn II		8	2562.08 Mo II		6	2566.91 Fe II	
32	2556.74 W I		46	2562.10 Ta I		2.0	2566.92 Rh II	
5	2556.75 Mo II		28	2562.13 V I		32	2567.05 Mo I	
10	2556.76 Co I		50	2562.15 Co I		1.8	2567.11 U	
5	2556.84 Ho I		24	2562.41 Nb II		4	2567.28 Rh	
24	2556.94 Nb II		2.5	2562.42 Ce		60	2567.35 Co I	
8	2557.15 Cr I		20	2562.53 Fe II		4	2567.45 Zr I	
8	2557.56 W I		13	2562.66 Os I		14	2567.50 W I	
18	2557.71 Ta II		12	2562.94 U		13	2567.51 Nb I	
8	2557.77 Os I		12	2563.01 Re I		38	2567.64 Zr II	
10	2557.94 Dy II		12	2563.15 Ru I		5	2567.73 Ho II	
12	2558.06 Re I		16	2563.16 Os II		2.5	2567.94 Th I	
10	2558.09 Os I		24	2563.16 W II		5	2567.96 U	
3.0	2558.48 W I		85	2563.21 Sc II		24	2567.99 Al I	
5	2558.54 Ru I		7	2563.28 Ir I		10	2568.17 Eu II	
2.0	2558.55 Pr		8	2563.33 Ta I		13	2568.21 W I	
10	2558.59 Mn II		13	2563.47 Fe II		4	2568.26 Tm II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
5	2568.39 V I		3.5	2572.37 Ir I		10	2576.69 Fe I	
10	2568.56 W I		6	2572.41 Ru I		18	2576.69 Th II	
44	2568.64 Re II		7	2572.48 Os		36	2576.82 Hf II	
17	2568.77 Ru I		5	2572.65 Ti II		14	2577.02 W I	
40	2568.83 Os I		11	2572.70 Ir I		22	2577.14 Eu II	
5	2568.87 U		60	2572.76 Mn I		36	2577.26 Ir I	
110	2568.87 Zr II		5	2572.93 Cd II		110	2577.27 Pb I	
1.8	2568.98 U		7	2573.09 Os I		6	2577.29 V I	
8	2568.98 W I		1.8	2573.13 Yb II		8	2577.32 U	
18	2569.03 Nb I		5	2573.14 Ce		70	2577.37 Ta II	
14	2569.13 Ta II		3.5	2573.40 Co I		10	2577.65 Cr I	
4	2569.17 Ce		4	2573.48 Os I		3.0	2577.73 Tb II	
20	2569.25 W I		20	2573.53 W I		40	2577.78 Ta I	
	2569.30 W II		4.0	2573.54 Co I		9	2577.92 Fe II	
4	2569.34 Tm II		50	2573.54 Ta I		4	2578.12 Re I	
1.2	2569.47 Sr I		12	2573.76 Re I		34	2578.14 Hf II	
20	2569.71 U		46	2573.79 Ta I		8	2578.16 Os I	
3.0	2569.74 Ru I		36	2573.90 Hf II		10	2578.20 Nb I	
2.5	2569.88 Ce		8	2573.95 W II		8	2578.24 Ta II	
10	2569.88 Ir I		30	2574.02 V I		14	2578.32 Os II	
16	2570.09 W I		8	2574.06 Sb I		2.0	2578.32 Pr	
6	2570.52 Fe II		4	2574.21 Re I		5	2578.36 Mo II	
5	2570.62 Ir I		50	2574.35 Co I		11	2578.57 Ru I	
9	2570.67 U		4	2574.37 Fe II		5	2578.71 Ir I	
6	2570.71 Hf II		18	2574.38 Ta I		36	2578.74 Nb I	
5	2570.78 Nb I		6	2574.42 Mo II		12	2578.77 Mo I	
11	2570.97 Ru I		6	2574.48 Th II		130	2578.79 Lu II	
12	2571.03 Ti II		5	2574.56 Tm III		3.5	2578.91 Ir I	
5	2571.05 Nb I		2.0	2574.66 Rh		6	2578.95 Ru I	
7	2571.14 Os I		2.5	2574.74 Os I		12	2579.01 Re I	
70	2571.23 Lu II		2.5	2574.76 Eu II		5	2579.16 U	
12	2571.26 Re I		8	2574.84 Nb II		5	2579.22 Ru I	
20	2571.33 Nb II		1.8	2574.86 Co II		20	2579.26 W II	
4	2571.35 Yb II		7	2574.89 Hf I		2.5	2579.30 Pr	
140	2571.39 Zr II		48	2575.10 Al I		20	2579.40 W I	
55	2571.44 W II		3.0 h	2575.24 Ru I			2579.54 W II	
2.5	2571.45 Mo II		4	2575.41 Al I		9	2579.43 Th II	
40	2571.51 Ta II		5	2575.46 W I		5	2579.44 U	
100	2571.58 Sn I		18	2575.47 Ta I		1.8	2579.49 Ir II	
100	2571.67 Hf II		50	2575.51 Mn I		11	2579.53 Ru I	
15	2571.74 Cr I		1.8	2575.73 Co I		5	2579.57 U	
32	2571.78 Os I		6	2575.74 Fe I		5	2579.59 Er II	
30	2571.81 Re II		2.0	2575.75 Rh I		12	2579.62 Ta I	
3.5	2572.07 Ir I		5	2575.77 Mo I		12	2580.03 Os II	
13	2572.10 Nb I		1200	2576.10 Mn II		70	2580.14 Tl I	
5	2572.24 Co I		1.0	2576.23 Rh		24	2580.16 Ta I	
18 d	2572.24 W II		6	2576.32 Re I		8	2580.28 Nb II	
	2572.35 W II		1.0	2576.32 Th I		8	2580.31 Re I	
3.0	2572.28 Ru I		5	2576.56 Mo II		40	2580.33 Co II	
40	2572.34 Mo I		10	2576.60 Nb I		30	2580.33 W I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
2.0	2580.35	Th II	6	2585.34	Co I	70	2590.94	Nb II
90	2580.49	W I	11	2585.43	W I	7	2590.97	Ru I
5	2580.70	Th II	12	2585.61	Ta I	4	2591.05	Ho II
10	2580.80	Ru I	5	2585.74	Ru I	18	2591.12	Ru I
1.6	2580.82	La II	65	2585.88	Fe II	6	2591.13	Re I
5	2580.82	Ti I	4	2585.95	Mo II	20	2591.25	U
6	2580.84	Co I	12	2586.08	Os	14	2591.33	Hf II
34	2581.05	Os I	2.0	2586.13	Gd II	3.0	2591.42	Tb II
14	2581.06	W I	1.2	2586.15	Th II	18	2591.49	W II
8	2581.14	Ru I	5	2586.20	U	5	2591.51	Dy II
4	2581.20	W II	4	2586.34	W I	9	2591.54	Fe II
12	2581.44	Re I	5	2586.52	Ho I	16	2591.59	Re I
9	2581.56	Er II	5	2586.64	W I	4	2591.64	Ru I
4	2581.60	Ta II	28	2586.73	Er II	6	2591.69	Co I
2.5	2581.86	Eu II	34	2586.79	Re I	5	2591.77	Mo II
7	2581.91	Ru I	12	2586.94	W I	38	2591.85	Cr I
70	2581.96	Os I	6	2587.00	Re I	3.5	2591.91	Er II
2.5	2582.11	U	11	2587.03	Er II	9	2591.98	Mo I
6 h	2582.13	Lu II	6 d	2587.07	U	19	2591.98	Os I
32	2582.16	Mo I	16	2587.22	Co II	13	2592.02	Ru I
16	2582.24	Co II	1.0	2587.25	Th II	36	2592.06	Ir I
5	2582.30	Fe I	3.0	2587.29	Rh II	48	2592.20	Nb I
36	2582.54	Hf II	3.5	2587.34	Er II	2.0	2592.34	Ce II
2.0	2582.56	La II	12	2587.49	Os I	8 d	2592.44	Ta I
9	2582.58	Fe II	10	2587.76	W I		2592.53	Ta II
10	2582.62	Os I	9	2588.00	Fe I	4	2592.54	Dy II
9	2582.77	Re	5	2588.20	Cr I	500	2592.54	Ge I
6	2583.04	Ru I	4	2588.26	Os I	13	2592.57	Er II
11	2583.11	Nb I	48	2588.27	Tm II	8	2592.57	U
1.8	2583.18	Ir I	8	2588.44	Os	2.5	2592.64	Tb II
8	2583.22	Nb I	8	2588.78	Mo II	3.0	2592.78	Fe II
8	2583.22	W I	4	2588.88	Ta II	8 h	2592.84	Re I
5	2583.40	Zr II	20	2589.06	Th II	32	2592.94	Mn I
4	2583.42	Tm II	9	2589.07	Zr II	6	2592.99	Ho I
3.0	2583.45	Th I	40	2589.17	W II	50	2593.08	Ta I
2.5	2583.48	U	28	2589.19	Ge I	7	2593.38	W I
70	2583.99	Nb II	5	2589.27	Nb I	9	2593.57	U
40	2584.03	Ta II	8	2589.39	Os I	20	2593.64	Ti I
8	2584.14	Ru I	5	2589.51	Os I	48	2593.66	Ta II
70	2584.31	Mn I	11	2589.57	Ru I	32	2593.70	Mo II
40	2584.38	W I	3.0	2589.59	U	11	2593.70	Ru I
8	2584.42	U	1.5	2589.65	Zr I	9	2593.73	Fe II
16	2584.49	Ta II	6	2589.71	Mn II	800	2593.73	Mn II
26	2584.54	Fe I	9	2589.81	Ta II	3.0	2593.90	Os I
12	2584.61	Tb II	3.0	2590.04	Au I	3.5	2594.12	Hf I
17	2584.69	Ta I	2.5	2590.20	Ta II	14	2594.14	Os I
6	2584.77	Re I	3.5	2590.26	Ti I	4	2594.16	Co I
5	2584.90	U	3.0	2590.31	Tb II	36	2594.25	Ta II
4	2585.22	W I	8	2590.59	Co I	8	2594.34	Nb II
12	2585.30	Dy I	95	2590.76	Os I	55	2594.42	Sn I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
17	2594.74 Nb II		7	2598.86 U		2.5	2603.32 Rh II	
14 c	2594.85 Re I		12	2598.90 Mn II		38 c	2603.33 Lu III	
12	2594.85 Ru I		36	2599.04 Ir I		12	2603.46 Re I	
4	2594.97 Tm II		10	2599.13 Os I		70	2603.49 Ta II	
12	2595.03 Er II		6	2599.22 Hf II		28	2603.54 W I	
5	2595.03 Th II		200	2599.40 Fe II		1.6	2603.55 U II	
16	2595.23 Re I		30	2599.57 Fe I		4	2603.57 Cr I	
65	2595.26 Ta I		6	2599.64 Mo I		6	2603.72 Mn II	
13	2595.40 Mo I		26	2599.86 Re I		6	2603.80 Os I	
14	2595.59 Ta II		14	2599.91 Os I		7	2603.82 Ta I	
32	2595.76 Mn I		28	2599.92 Ti I		26	2603.89 Re I	
16	2596.00 Os II		26	2600.14 Ta I		5	2604.31 U	
5	2596.00 Pt I		7	2600.18 Dy II		15	2604.38 W I	
4	2596.09 La II		10	2600.45 Os I		9	2604.55 Ir I	
10	2596.12 Ta I		8	2600.73 Ta II		18	2604.60 Os I	
2.5	2596.14 Yb II		8	2600.74 W I		2.5	2604.61 Eu I	
4	2596.29 Yb II		6	2600.75 Os I		8	2604.86 Er I	
5	2596.34 W		7	2600.78 Dy II		4	2604.96 Os I	
2.5	2596.37 Os I		6	2600.87 Re I		5	2605.08 Mo II	
10	2596.40 Re I		20	2600.89 Th II		36	2605.15 Ti I	
36 l	2596.45 Ta II		3.0	2600.98 Co I		7	2605.32 Ta I	
19 h	2596.49 Tm I		16	2601.06 Ta I		8	2605.35 Ru I	
7	2596.58 Ti I		12	2601.08 Tm I		18	2605.51 W I	
7	2596.61 Ta I		13	2601.29 Nb II		8	2605.65 Fe I	
7	2596.67 W I		9	2601.46 Ru I		550	2605.69 Mn II	
14	2596.69 Os I		11	2601.54 U		12	2605.86 Ho II	
5	2596.77 Mo I		10	2601.69 Mo I		7	2605.86 Ru I	
14	2596.78 Re I		20	2601.76 In I		5	2605.93 Mo II	
10	2596.95 Re I		6	2601.84 Nb I		24	2606.01 Tm II	
20	2597.05 Th II		8	2601.87 Re I		5	2606.12 Co I	
8	2597.14 Nb I		38	2601.96 W I		44	2606.37 Hf II	
14	2597.20 Os I		5	2602.01 Nb I		70	2606.39 W I	
	2597.29 Os I		7	2602.04 Ir I		8	2606.43 Ta II	
4	2597.22 Mo I		5	2602.14 Mn I		6	2606.44 Rh II	
5	2597.33 Ru I		9	2602.33 Os I		8	2606.52 U	
5	2597.38 Mo II		10	2602.38 Ta I		3.0	2606.69 Er II	
12	2597.58 Os I		8	2602.51 W II		8	2606.73 U	
14	2597.69 U		5	2602.55 Re I		16	2606.82 Fe I	
6	2597.71 Tb II		8	2602.66 Er I		8	2606.90 W I	
8	2597.73 W I		6	2602.67 Hf I			2606.98 W II	
6	2597.96 Re I		13	2602.80 W I		50	2607.03 Hf II	
3.0 h	2598.05 Pr		32	2602.80 Mo II		90	2607.05 Tm II	
600	2598.05 Sb I		3.0	2602.87 Hf I		65	2607.09 Fe II	
	2598.09 Sb I		8	2602.93 Re I		6	2607.24 Hf II	
2.5	2598.07 Rh		4	2602.93 Tb II		5	2607.32 Re I	
12	2598.21 Ta II		8	2603.02 W II		32	2607.37 Mo I	
65	2598.37 Fe II		7	2603.14 Pt I		33	2607.38 W I	
7	2598.42 W I		6	2603.22 Os		2.5	2607.48 Th II	
11	2598.74 W II		4	2603.31 Nb I		9	2607.52 Ir I	
5	2598.75 Ta I		3.5	2603.32 Mo I		14	2607.84 Ta II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
6	2608.20 Ta I		90	2612.07 Ru I		6	2615.96 Os I	
8	2608.20 U		19	2612.19 W I		4	2615.99 Tm II	
34	2608.25 Ir I		34	2612.31 Sb I		6	2616.07 U	
2.0	2608.32 Th II		6	2612.37 Er II		6	2616.26 Co I	
38	2608.32 W I		11	2612.38 Nb I		8	2616.31 Tm II	
13	2608.45 Hf I		5	2612.46 U		19	2616.48 Nb I	
60	2608.50 Re II		2.5	2612.59 Hf I		10	2616.61 Hf I	
11	2608.57 Tb II		13	2612.61 Ta II		14 c	2616.72 Re II	
160	2608.63 Ta I		44	2612.63 Os I		50	2616.78 Mo I	
4	2608.67 Dy II		170	2613.06 Os I		6	2616.87 Er II	
5 h	2608.84 Nb I		100	2613.07 W I		4	2616.90 Tb	
4	2608.86 Mo I		36	2613.08 Mo I		4	2616.99 Tm	
2.0	2608.89 Pr		120	2613.40 Lu II		14	2617.00 Yb II	
5	2608.96 Nb II		5	2613.49 Co I, II		9	2617.11 Re I	
6	2608.99 Tl I		8	2613.59 Tm II		5	2617.18 Os I	
24	2609.00 Ta I		26	2613.60 Hf II		8	2617.44 Re I	
40	2609.06 Ru I		6	2613.60 Rh		32	2617.62 Fe II	
20	2609.20 Os I		50	2613.65 Pb I		16	2617.78 Ir I	
4	2609.26 U		10	2613.74 Re I		8	2617.79 Ru I	
5	2609.43 Zr I		32	2613.82 Fe II		4	2617.86 Co I	
6	2609.46 Tm II		50	2613.82 W I		12	2618.02 Fe I	
5	2609.48 Ru I		2.0	2613.85 Nb II		40	2618.37 Cu I	
5	2609.50 Ce		5	2613.90 Ce		20	2618.81 W I	
36	2609.56 Os I		9	2613.95 U		20	2618.90 Th II	
9	2609.86 Th II		6	2613.99 Ho II		26	2619.18 W I	
2.0	2609.90 Ce		5	2614.06 Os I		120	2619.26 Lu II	
4	2609.96 Hf I		10	2614.07 Ru I		5	2619.28 Os	
2.5	2610.07 Sm I		4	2614.13 Co I		9	2619.34 Mo II	
4	2610.13 Ta I		700	2614.18 Pb I		5	2619.57 Pt I	
24	2610.20 Mn II		8	2614.29 Hf II		10	2619.67 Ru I	
13	2610.28 Nb I		8	2614.36 Co II		10	2619.88 Ir I	
46	2610.34 La II		2.5	2614.50 Os I		75	2619.94 Os I	
7	2610.51 Ho II		5	2614.54 Er II		28	2619.94 Ti I	
5	2610.74 W I		14	2614.56 Re I		15	2620.03 Re I	
2.0	2610.76 Co I		6	2614.59 Ru I		6	2620.18 Ta I	
38	2610.78 Os I		10	2614.98 Ir I		50	2620.23 W I	
9	2611.05 Ru I		11	2615.09 Ru I		12	2620.29 V I	
24	2611.20 Mo I		24	2615.12 W I		15	2620.34 Re I	
3.0	2611.22 Sc II		8	2615.25 Ta I		9	2620.41 Fe II	
48	2611.28 Ti I		3.0	2615.26 Yb II		12	2620.45 Nb II	
85	2611.30 Ir I		16	2615.39 Mo I		9	2620.61 Ru I	
10	2611.33 Os I		1200	2615.42 Lu II		22	2620.62 Os I	
36 d	2611.34 Ta I		7	2615.44 W II		4	2620.93 Tm II	
	2611.46 Ta I		40	2615.46 Ta I		18	2621.07 Mo I	
7	2611.48 Ti I		36	2615.66 Ta I		17	2621.67 Fe II	
55 d	2611.54 Re I		5	2615.68 Re I		8	2621.72 Er II	
	2611.60 Re I		2.0	2615.75 Pr		4	2621.81 U	
2.0	2611.62 Th I		3.5 d	2615.88 Ir I		50	2621.82 Os I	
80	2611.87 Fe II			2616.00 Ir I		2.0	2622.00 Nb I	
3.5	2612.04 Ir I		3.0	2615.95 U		5	2622.06 Co I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
8	2622.21	Tm II	4	2627.77	Er II	5	2632.50	Ru I
50	2622.21	W I	70	2627.91	Bi I	14	2632.52	Nb II
5	2622.43	Co I	110	2628.03	Pt I	10	2632.66	U
12	2622.58	Rh I	2.5	2628.20	Ir I	50	2632.70	W I
50	2622.74	Hf II	26	2628.25	W I	10	2632.89	Os I
18	2622.76	Re I	24	2628.28	Pb I	14	2632.98	U
4	2622.86	Cr I	32	2628.29	Fe II	4	2633.01	Re I
18	2622.90	Mn I	36	2628.48	Os I	100	2633.13	W I
8	2623.28	Re I	19	2628.49	Nb I	4	2633.33	Th II
4	2623.32	Hf I	5	2628.50	U	3.0	2633.46	Ru I
24	2623.45	Th II	14	2628.69	Tb II	12	2633.61	Re I
20	2623.51	Nb I	20	2628.74	Mo I	10	2633.79	Ta II
15	2623.53	Fe I	5	2628.81	Th II	34	2634.17	Ir I
5	2623.54	U	8	2628.85	Ta II	6	2634.29	Os I
6	2623.61	Os I	20 d	2628.89	W I	8	2634.31	Yb II
3.5	2623.64	Ir II		2629.00	W II	6	2634.44	Os I
20	2623.70	Dy I	12	2628.93	U	6	2634.71	Nb I
3.0	2623.83	Ru I	10	2628.97	Mo I	10	2634.78	Ba II
19	2624.04	Mn I	2.0	2629.15	U	24	2634.81	Dy II
20	2624.12	Ta I	2.0	2629.41	Ir I	3.0	2634.99	Rh
14	2624.18	Er II	4	2629.59	Fe I	6	2635.15	Ce
75	2624.34	Tm II	7	2629.78	Tm II	8	2635.27	Ir I
6	2624.57	Os I	2.0	2629.82	Cr I	9	2635.42	Zr I
5	2624.80	Mn II	55	2629.85	Mo I	3.0	2635.50	Eu II
2.5	2624.82	Ga I	1.6	2630.02	Th II	36	2635.53	U
8	2624.92	U	4	2630.26	Mn I	3.0	2635.57	Hf I
4	2625.04	Re I	8	2630.42	Rh I	9	2635.57	Mo I
4	2625.20	Ho II	9	2630.53	Ta II	140	2635.58	Ta II
50	2625.22	W I	8	2630.57	Mn I	7	2635.79	Hf II
8	2625.26	U	19	2630.67	V II	16	2635.81	Fe I
2.5	2625.32	Cr I	5 c	2630.75	Re I	28	2635.83	Re II
12	2625.32	Ir I	17	2630.91	Zr II	24	2635.86	Ru I
10	2625.46	Ta I	55	2631.05	Fe II	8	2635.93	Ta I
26	2625.58	Mn II	2.5	2631.22	Os II	3.0	2636.25	U
44	2625.67	Fe II	5	2631.26	U	6	2636.37	Ta I
2.0	2625.67	Ir I	24	2631.28	Si I	36	2636.55	W I
24	2625.74	Th II	24	2631.30	Ru I	50	2636.64	Re I
4	2625.86	U	55	2631.32	Fe II	42	2636.67	Mo II
18	2625.88	Rh I	8	2631.50	Mo I	18	2636.67	Ru I
10	2626.24	W I	16	2631.54	Ti I	55	2636.67	Ta I
2.5	2626.40	Th II	8	2631.57	Re I	100	2636.90	Ta I
2.0	2626.60	Cr I	6	2631.57	Ru I	18	2637.00	Hf I
12	2626.64	Mn I	5	2632.13	Ru I	17	2637.01	Re II
5	2626.76	Ir I	4	2632.23	Tm II	360	2637.13	Os I
8	2626.95	Hf II	7	2632.24	Co II	6	2637.23	Tm II
5	2627.43	Ta I	8	2632.24	Fe I	6	2637.70	U
19	2627.44	Nb I	12	2632.27	Ta II	3.5	2637.81	Er III
40	2627.55	Mo I	24	2632.35	Mn II	6	2637.93	Ta II
14	2627.64	Co I	16	2632.42	Ti I	5	2637.98	Nb II
6	2627.65	Ru I	50	2632.49	W I	6	2637.98	Os I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
16	2638.17 Mn II		16	2641.60 Os I		70	2646.37 Ta I	
32	2638.30 Mo I		6	2641.65 Fe I		16	2646.42 Co I	
7	2638.41 Tm II		12	2641.90 Yb II		4	2646.44 Yb II	
10	2638.51 Ru I		6	2641.93 U		13	2646.45 Tm II	
1.6	2638.6 U		8	2642.08 Hf I		46	2646.49 Mo II	
50 d	2638.61 W I		4	2642.12 Cr I		90	2646.64 Ti I	
	2638.75 W I		6	2642.16 Dy I		18 d	2646.74 Ta II	
10	2638.67 Ta II		17	2642.21 V II			2646.89 Ta II	
120	2638.71 Hf II		30	2642.24 Nb II		50	2646.74 W I	
2.5	2638.74 Rh II		11	2642.55 Yb III		32	2646.89 Os I	
90	2638.76 Mo II		1.2	2642.61 Th II		100	2646.89 Pt I	
95	2638.77 Eu II		18	2642.75 Hf I		2.0	2647.02 U	
1.6	2638.97 Ir I		24	2642.75 Re I		20	2647.10 W I	
3.0	2639.01 U		4	2642.83 Tm II		2.5	2647.11 Ce	
24	2639.09 Zr II		50	2642.96 Ru I		14	2647.13 Re I	
8	2639.12 Ru I		6	2643.00 Rh		4	2647.14 Er II	
6	2639.19 Ta II		20	2643.12 W I		4	2647.25 Mo I	
13	2639.35 Pt I		6	2643.16 V I		9	2647.28 Rh I	
12	2639.42 Ir I		1.4	2643.24 U		75	2647.29 Hf II	
6	2639.44 Yb II		1.2	2643.27 Th II		12	2647.32 Ru I	
4	2639.49 Mo I		8	2643.40 Zr II		4	2647.46 Yb II	
3.5	2639.51 Th II		4	2643.50 Tm II		280	2647.47 Ta I	
4	2639.68 Mo I		1.4	2643.54 U		50	2647.50 Nb I	
170	2639.71 Ir I		8	2643.63 Os I		1.4	2647.53 U	
10	2639.84 Mn II		5	2643.81 MO I		3.0	2647.56 Fe I	
8	2639.84 U		20	2643.89 Ta I		12	2647.71 V I	
1.2	2639.88 Th II		12	2644.00 Fe I		36	2647.73 Os I	
4	2639.89 U		180	2644.11 Os I		9	2647.74 W II	
2.5	2639.98 Os I		8	2644.12 U		6	2647.78 Zr I	
5	2640.09 Ho II		6	2644.19 Ge I		7	2648.14 Tm II	
5	2640.27 Sm		10	2644.19 Ir I		2.0	2648.30 Ce	
1.2	2640.27 Th II		75	2644.26 Ti I		3.5	2648.45 Ru I	
10	2640.28 Mo I		16	2644.30 Yb II		6	2648.46 Re II	
5	2640.30 Ho II		75	2644.35 Mo II		2.0	2648.47 Pr	
12	2640.33 Ru I		6	2644.36 V II		40	2648.64 Co I	
2.5	2640.38 Ir I		2.5	2644.48 U		3.0	2648.78 Ru I	
1.2	2640.40 Th II		14	2644.60 Ta II		4	2648.79 U	
5	2640.69 V I		10	2644.60 W I		4	2648.80 Yb II	
22	2640.77 Tm II		3.0	2644.78 Co I		24	2649.05 Re I	
14	2640.92 Nb I		14	2645.10 Ta II		15	2649.07 U II	
52	2640.99 Mo I		20	2645.26 V I		5	2649.15 Hf II	
8	2641.02 Re II		6	2645.32 Dy II		2.0	2649.17 Sm	
4	2641.06 Nb II		28	2645.47 U		4	2649.25 Mo I	
60	2641.10 Ti I		26	2645.69 W I		3.0	2649.30 Ti I	
6	2641.17 Os I		4	2645.79 Mo I		2.5	2649.33 Ce	
36	2641.27 Eu II		11	2645.84 V II		36	2649.34 Os I	
120	2641.41 Hf II		3.0	2646.02 Ru I		80	2649.46 Mo I	
26	2641.49 Au I		80	2646.19 W I		4	2649.48 Th II	
24	2641.49 Th II		60	2646.22 Ta I		7	2649.51 Ru I	
4	2641.55 U		48	2646.26 Nb II		36	2649.52 Nb I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
4	2649.58 Re I		10	2653.57 W II		1.6	2657.09 Pb I	
4	2649.68 Ho II		28	2653.59 Cr II		3.5	2657.19 Ti I	
7	2649.79 Yb II		4	2653.61 Eu II		8	2657.30 Ta I	
4	2649.87 Th II		7	2653.73 Er II		50	2657.38 W I	
4	2649.94 Co I		140	2653.74 Yb II		7	2657.50 Hf II	
10	2649.98 W I		8	2653.76 Ir I		24	2657.62 Nb I	
6	2650.02 Ta I		14	2653.78 Os I		3.0	2657.68 Sm	
5	2650.27 Co I		6	2653.83 V I		1.6	2657.71 Ir I	
16	2650.27 Tm II		3.5	2653.95 Ir I		180	2657.80 Lu II	
8	2650.28 Ta I		2.5	2654.01 Ta I		18	2657.84 Hf II	
12	2650.38 Zr II		4	2654.11 Er II		1.4 d	2657.86 U	
140 c	2650.47 Be I		36	2654.12 Re I		50 d	2658.04 W II	
	2650.55 Be I		50	2654.45 Nb I			2658.19 W I	
	2650.62 Be I		6	2654.58 U		36	2658.11 Mo I	
	2650.64 Be I		16	2654.67 W I		6	2658.14 Ta II	
	2650.70 Be I		2.5	2654.75 Pr		2.0	2658.17 Pt I	
	2650.78 Be I		1.4	2654.93 Ti I		1.4 d	2658.36 U	
15	2650.58 Th II		70 h	2655.03 Mo I		5	2658.40 Ru I	
5	2650.68 Mo I		4	2655.18 Re I		19	2658.48 Tm II	
6	2650.68 Os I		6	2655.19 Os I		28	2658.59 Cr II	
4	2650.73 Yb II		7	2655.25 Er II		180	2658.60 Os I	
50	2650.86 Pt I		10 d	2655.55 W		13	2658.66 Th II	
3.5	2650.99 Mn II			2655.67 W II		8	2658.69 Zr I	
24	2651.01 Ce		4	2655.68 Ta I		14	2658.86 Ta II	
13	2651.12 Nb II		7	2655.68 V II		4	2658.88 Nb II	
11	2651.16 Hf II		6	2655.70 Nb I		4	2658.98 V II	
1200	2651.18 Ge I		5	2655.78 Os I		2.5	2659.01 Rh I	
32	2651.22 Ta II		4	2655.84 Re I		6	2659.02 Re I	
12	2651.29 Ru I		8	2655.91 Mn II		4	2659.02 U	
3.5	2651.35 Er II		5	2655.93 Mo I		3.0	2659.26 Yb II	
550	2651.58 Ge I		6	2655.96 Tb II		10	2659.41 Ta II	
36	2651.84 Ru I		46	2656.08 Nb II		280	2659.45 Pt I	
60	2651.90 Re I		5	2656.08 Ta I		5	2659.46 U	
19	2651.90 V I		7	2656.10 Er II		4	2659.61 V II	
5	2652.32 Ta I		5	2656.11 Yb II		44	2659.62 Ru I	
15	2652.49 Al I		4	2656.15 Fe I		4	2659.66 Ta I	
32	2652.60 Sb I		20	2656.22 V I		6	2659.79 Re I	
20	2652.61 W I		3.0	2656.25 Ru II		60	2659.83 Os I	
32	2652.66 Rh I		4 d	2656.46 U		34	2659.87 Ga I	
12	2652.83 U		5	2656.49 Mo I		4	2660.04 Nb II	
3.5	2652.86 Hf II		200	2656.54 W I		26	2660.09 Tm II	
12	2652.91 Re I		1.4	2656.56 Ru I		8	2660.14 U	
6	2652.92 V I		220	2656.61 Ta I		20	2660.39 Al I	
5	2652.94 Nb I		46	2656.68 Os I		10	2660.52 W I	
14	2652.98 Os I		1.4	2656.69 Ru I		4	2660.54 Re I	
300	2653.27 Ta I		5	2656.81 Ir I		80	2660.58 Mo II	
60	2653.35 Mo II		2.5	2656.84 Ce		9	2660.92 Os I	
14	2653.38 Nb I		10	2656.98 Nb I		2.5	2661.17 Ru II	
3.5	2653.41 Tm II		6	2657.00 Er II		4	2661.17 U	
5	2653.42 W II		6	2657.05 Lu		36	2661.18 Os I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
140	2661.24	Sn I	16	2665.25	Nb II	20	2669.17	U
180	2661.34	Ta I	8	2665.57	Tl I	15	2669.29	Tb II
3.0	2661.39	Th II	26	2665.60	Ta II	26	2669.30	W I
5	2661.40	Tb II	6	2665.70	U	1.6	2669.45	Th II
24	2661.42	V I	20	2665.77	W I	4	2669.46	Ir I
2.0	2661.50	Gd II	6	2665.87	U	6	2669.49	Zr II
10	2661.56	W I	1.6	2665.89	Th II	14	2669.53	Os I
36	2661.61	Ru II	4	2665.94	Ta I	18	2669.58	Ta II
2.5	2661.64	Tb II	4	2665.96	V I	9	2669.60	Ti I
8	2661.73	Cr II	10	2665.97	Hf II	5	2669.77	W I
6	2661.86	Nb I	11	2665.99	Os	38	2669.91	Ir I
24	2661.88	Hf II	50	2666.02	Cr II	6	2670.24	Re I
18	2661.89	Ta I	12	2666.11	Yb III	48	2670.26	Er II
4	2661.93	Os I	11	2666.21	Os I	8	2670.32	Mo I
8	2661.97	Ti I	7	2666.24	Ho II	8	2670.52	U
130	2661.98	Ir I	9	2666.30	Er II	38	2670.64	Sb I
3.0	2662.06	Fe I	9	2666.49	W II	10	2670.79	Re I
15	2662.10	Ta I	6	2666.50	Ce II	3.0	2670.89	U
5	2662.34	Th II	8	2666.54	U	13	2670.96	Zr II
5	2662.42	Sm I	17	2666.59	Nb II	2.5	2671.06	Rh I
10	2662.55	Os I	5	2666.64	Fe II	5	2671.25	Hf II
26	2662.63	Ir I	2.0	2666.67	Pr	1.6	2671.47	Th II
100	2662.84	W I	6	2666.75	Mo I	100	2671.47	W I
3.5	2662.86	Th II	10	2666.82	Fe I	12	2671.63	Ta I
300	2663.16	Pb I	12	2666.98	Yb III	4	2671.67	V I
10	2663.22	Os I	6	2667.00	Mn I	40	2671.81	Cr II
6	2663.31	Ir I	5	2667.00	Ta II	7	2671.83	Mo II
36	2663.42	Cr II	6	2667.13	Re I	38	2671.84	Ir I
8	2663.53	Co II	6	2667.15	Nb II	14	2671.84	Re I
4	2663.56	Nb II	6	2667.17	Ta I	60	2671.93	Nb II
20	2663.63	Re I	17	2667.30	Nb II	55	2671.98	Yb I
8	2663.68	Cr II	3.5	2667.40	Ru II	38	2672.00	V II
3.0	2663.88	Ta II	1.0	2667.54	Th II	6	2672.21	U
10	2663.94	W I	6	2667.64	Tb II	32	2672.26	Er II
2.0	2664.06	Th II	13	2667.76	Nb II	1.6	2672.48	Pr
10	2664.15	U	20	2667.80	Zr II	12	2672.50	Ta II
6	2664.22	Re I	4	2667.97	Ru I	14	2672.59	Mn II
6	2664.24	Ta II	3.0	2668.02	U	55	2672.65	Yb II
4	2664.29	Os II	6	2668.07	Dy I	3.0	2672.69	U
20	2664.32	W I	26	2668.07	Ta I	7	2672.77	Re I
	2664.34	W II	14	2668.20	Tm II	32	2672.83	Cr II
5	2664.46	Tm II	10	2668.28	Hf I	90	2672.84	Mo II
7	2664.66	Fe II	19	2668.29	Nb I	6	2672.91	La II
22	2664.76	Ru I	60	2668.34	Eu II	1.6	2672.94	Th
200	2664.79	Ir I	70	2668.62	Ta I	4	2673.07	Ce II
6	2664.81	Re I	32	2668.71	Cr II	5	2673.23	V II
32	2664.96	W I	8	2668.74	Yb II	32	2673.27	Mo II
28	2665.02	Yb II	5	2668.86	Tb II	7	2673.37	Mn II
8	2665.04	Er II	10	2668.99	Ir I	10	2673.42	Eu II
14	2665.10	Mo I	9	2669.00	Hf II	6	2673.48	Ru I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
30	2673.57	Nb II	50	2677.80	V II	10	2682.19	Os I
1.4	2673.58	U	5	2678.09	Tm II	10	2682.31	Tm III
10	2673.59	W II	3.0	2678.15	Tb II	2.0	2682.46	Ir I
5	2673.60	Ru I	4	2678.16	Cr I	4	2682.62	Mo I
24	2673.61	Ir I	24	2678.29	Eu II	5	2682.73	Ce II
2.5	2673.84	Mo I	2.0	2678.43	Hf II	14	2682.76	Sb I
4	2674.13	Tb II	5	2678.52	W I	24	2682.87	V II
6	2674.18	Ta II	36	2678.57	V II	6	2683.02	Mn I
85	2674.34	Re I	200	2678.63	Zr II	24	2683.09	V II
7	2674.43	Mn II	10	2678.66	Nb II	80	2683.23	Mo II
4	2674.49	Ta I	4	2678.67	Mo I	28	2683.28	U
55	2674.57	Os I	75	2678.76	Ru II	36	2683.34	W I
4	2674.57	Pt I	36	2678.79	Cr II	32	2683.35	Hf II
4	2674.69	Tb II	8	2678.80	Ta II	2.0	2683.42	Yb II
8	2674.70	W I	1.4	2678.86	U	12	2683.56	Re I
38	2674.88	Os I	50	2678.88	W I	3.0	2683.75	Mn I
4	2674.98	Tm II	1.6	2678.93	Th II	4	2683.97	Tb II
8	2675.12	U	14	2679.01	Nb I	8	2684.04	Ir I
5	2675.13	W I	18	2679.06	Fe I	9	2684.04	U
8	2675.15	Sm	7	2679.06	Ir I	10	2684.08	Tm II
10	2675.35	Er II	12	2679.10	Re I	110	2684.14	Mo II
5	2675.40	W I	50	2679.32	V II	1.4	2684.23	Sc II
3.0	2675.67	Th II	5	2679.38	Os I	70	2684.28	Ta I
16	2675.87	W I	32	2679.56	Tm II	1.4	2684.29	U
8	2675.88	U II	7	2679.74	Os I	32	2684.29	Th II
90	2675.90	Ta II	6	2679.76	Co I	7	2684.36	Os I
30	2675.94	Nb II	130	2679.85	Mo I		2684.41	Os
340	2675.95	Au I	14	2679.91	Re I	7	2684.55	Mn II
6	2675.98	Co I	12	2679.93	Ti I	10	2684.75	Yb II
5	2676.11	Rh I	16	2680.04	W I	2.5	2684.80	Ti I
4	2676.33	Mn I	7	2680.06	Nb II	38 h	2685.08	Lu I
13	2676.41	U	32	2680.06	Ta II	3.0	2685.14	Ti I
6	2676.48	Ta II	2.0	2680.28	Rh	6	2685.14	V I
2.5	2676.63	Hf II	2.0	2680.34	Cr II	180	2685.17	Ta II
2.0	2676.69	U	6	2680.34	Mn II	2.5	2685.18	Pr
9	2676.83	Ir I	3.0	2680.40	Yb II	6	2685.22	Hf II
4	2676.84	Dy II	8	2680.63	Rh I	6	2685.31	Re I
14	2677.03	Re I	26	2680.66	Ta II	9	2685.34	Co I
6	2677.12	Tm II	4	2681.10	Ir I	6 h	2685.54	Lu I
44	2677.15	Pt I	12	2681.36	Mo II	4	2685.61	U
200	2677.16	Cr II	260	2681.41	W I	24	2685.66	Eu II
11	2677.16	Te I	3.0	2681.63	Ta I	9	2685.69	V II
6 h	2677.25	Lu I	2.0	2681.65	Y I	3.5	2685.70	Pr
80	2677.28	W I	5	2681.72	Mn I	7	2685.94	Mn II
3.5	2677.32	Dy II	2.0 d	2681.73	U	16	2685.98	U
2.0	2677.58	Hf II	4	2681.76	Zr II	3.5 d	2686.20	Tm II
4	2677.66	Nb II	2.5	2681.78	Rh I		2686.32	Tm II
12	2677.76	Re I	13	2681.87	Ta I	24	2686.29	Ru I
20 d	2677.79	W II	4	2682.13	Nb I	4	2686.29	Ta I
	2677.91	W I	4	2682.19	Hf I	2.0	2686.36	Hf I

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
6	2686.36 V I		2.0	2691.03 Th I		4	2694.31 Rh I	
	2686.51 V I		32	2691.04 Cr II		7	2694.39 Re I	
10	2686.39 Nb II		19	2691.04 U		13	2694.52 Os I	
2.5 h	2686.50 Rh		4	2691.06 Ir I		55	2694.52 Ta II	
2.5 h	2686.91 Rh		26	2691.09 W I		3.0	2694.68 Co II	
26	2687.09 Cr II		4	2691.18 Th II		6	2694.75 Os I	
11	2687.13 Th II		40	2691.31 Ta I		17	2694.76 Ta I	
19	2687.15 Nb I		500	2691.34 Ge I		1.6	2695.02 Th II	
10	2687.37 W I		2.5	2691.69 Ce		14	2695.04 Nb I	
3.0	2687.50 Ru II		24	2691.77 Nb II		7	2695.21 Th II	
10	2687.75 Zr I		6	2691.80 Ta II		7	2695.22 Mo II	
3.5	2687.84 Tb II		6	2691.80 U		7	2695.36 Mn II	
140	2687.96 V II		5	2691.90 Tb II		3.0	2695.39 Y I	
3.5	2687.96 Yb II		55	2692.03 Eu II		4	2695.43 Yb II	
2.5	2687.99 Ce		36	2692.06 Ru II		8	2695.43 Zr II	
70	2687.99 Mo II		5	2692.16 W I		3.5	2695.46 Tb II	
7	2688.04 Cr I		5	2692.25 Sb I		7	2695.47 La II	
10	2688.08 Os I		20	2692.34 Ir I		12	2695.49 U	
3.5	2688.11 Ru I		12	2692.36 U		5	2695.54 Ta II	
	2688.16 Ru II		30	2692.40 Ta I		14	2695.56 Re I	
14	2688.25 Mn II		42	2692.42 Th II		10	2695.56 Th II	
6	2688.29 Cr II		10	2692.60 Zr II		80	2695.67 W I	
1.6	2688.34 Th II		4	2692.61 Mo II		3.0	2695.71 Ta II	
2.0	2688.35 Hf I		11	2692.66 Mn I		2.5	2695.81 Th II	
4	2688.40 Er II		14	2692.70 Os I		10	2695.85 Co I	
20	2688.53 Re I		10	2692.78 Sc I		3.0	2695.91 U	
7	2688.60 Sm		5	2692.83 Ta II		15 d	2695.96 Ce II	
6	2688.64 Mo I		6	2692.85 Dy II			2696.07 Ce II	
3.0	2688.71 Au I		2.0	2692.88 Ir I		6	2696.05 Nb I	
22	2688.72 V II		2.5	2692.92 Zr I		8	2696.07 Mo I	
6	2688.82 Ti I		3.5	2693.04 Mo I		4	2696.08 Sm	
6	2689.03 Ho II		3.5	2693.05 Tb II		8	2696.18 Hf I	
1.4	2689.13 U		3.5	2693.19 Mn II		2.5	2696.30 U	
12	2689.21 Fe I		4	2693.29 Ru I		3.0	2696.49 Ni I	
12	2689.24 Ta II		9	2693.34 Sm		4	2696.61 Os I	
6	2689.29 Dy II		11	2693.34 Ta I		2.0	2696.62 Yb II	
10	2689.35 Os I		6	2693.41 Tb II		28 c	2696.76 Bi I	
200	2689.82 Os I		3.5	2693.47 Tm II		28	2696.81 Ta I	
20	2689.88 V II		2.0	2693.49 Ir I		4	2696.83 Mo II	
2.0	2689.90 Ru I		6	2693.50 Ta I		5	2696.83 Tb II	
4	2689.93 Er II		4	2693.52 Cr II		3.5	2696.83 Th II	
3.5	2689.99 Tm II		2.5	2693.53 Mo I		16	2696.99 V I	
30	2690.24 V II		18	2693.53 Zr II		150	2697.06 Nb II	
10 h	2690.25 Re I		3.0	2693.74 Sm I		8	2697.24 Os	
3.0	2690.26 Cr I		10	2693.77 U		8	2697.26 Re I	
8	2690.51 U		1.6	2693.97 Th II		6	2697.40 U	
4	2690.54 Ta I		20	2694.06 Zr II		17	2697.50 Tm II	
4 h	2690.79 Re I		7	2694.21 Y		16	2697.51 W I	
32	2690.79 V II		3.0	2694.22 U		4	2697.54 Th II	
3.0	2690.90 Sm		220	2694.23 Ir I		26	2697.71 W II	

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16	2697.74	V I	70	2701.14	Eu II	2.0	2705.43	Cr I
11	2697.81	Mo I	12	2701.34	Ru I	75	2705.61	Hf I
4	2697.91	Cr II	60	2701.42	Mo II	3.0	2705.63	Rh II
16	2698.06	U	5	2701.48	W II	16	2705.74	Mn II
4 h	2698.26	Tm III	3.5	2701.52	Tb II	1.6	2705.77	U
120	2698.30	Ta I	5	2701.55	U	3.0	2705.85	Co I
6	2698.39	Er III	6	2701.69	Er II	160	2705.89	Pt I
20	2698.41	Cr II	20	2701.70	Mn II	10	2706.01	W I
20	2698.43	Pt I	280	2701.71	Lu II	6	2706.02	Fe I
6	2698.45	U	2.5	2701.82	Th II	4	2706.06	Re I
20	2698.69	Cr II	4	2701.87	Mo II	12	2706.12	Mo I
6	2698.73	V I	80	2701.90	Eu II	70	2706.17	V II
6	2698.74	Th II	4	2701.95	Tm II	10	2706.17	Zr I
4	2698.79	Re I	13	2701.99	Cr I	10	2706.28	Tb II
20	2698.84	W I	20	2702.11	W II	14	2706.40	Nb II
48	2698.86	Nb II	50	2702.19	V II	700	2706.51	Sn I
5	2698.92	Pr	48	2702.20	Nb II	18	2706.58	Fe I
3.5	2698.97	Mn II	3.0	2702.22	Pr	50	2706.58	W I
8	2699.11	Fe I	200	2702.40	Pt I	55	2706.69	Ta I
5	2699.11	Sc III	5	2702.46	Nd	55	2706.70	Os I
4	2699.11	V I	22	2702.52	Nb II	20	2706.70	V II
1.4	2699.37	U	26	2702.52	W I	12	2706.73	Hf II
7	2699.41	Mo II	2.0	2702.53	Cr I	30	2706.77	Sc I
4	2699.47	Tm III	3.0	2702.63	Ba I	10	2706.88	Ce II
3.0	2699.58	Re I	7	2702.67	Re I	2.0	2706.88	Ir I
48	2699.59	Os I	14	2702.80	Ta II	3.5	2706.92	Ta I
80	2699.59	W I	7	2702.83	Os I	22	2706.95	U
11	2699.60	Zr II	12	2702.83	Ru I	8	2707.01	Tm III
7	2699.63	Hf I	10	2703.06	Ta I	5	2707.02	W
4	2699.82	Tm III	8	2703.48	Cr I	3.0	2707.23	Rh I
10	2699.88	Ru I		2703.55	Cr II	10 h	2707.35	Pr
50	2700.01	W I	32	2703.73	Rh I	3.0	2707.40	Re I
85	2700.13	Zr II	4	2703.86	Cr II	17	2707.42	Os I
6	2700.15	Nb II	24	2703.96	Th II	10	2707.53	Mn II
5	2700.17	Tm II	4	2703.99	Fe II	5	2707.83	Nb II
8	2700.21	Mo I	8	2704.03	Ir I	14	2707.86	V II
6	2700.35	Pr	20	2704.07	Tb II	8	2707.88	W I
3.0	2700.56	Nb II	4	2704.18	Ho II	17	2707.95	Sc I
2.0	2700.60	Cr I	6 h	2704.26	Nb II	6	2707.96	Sm
1.6	2700.60	Th II	10	2704.31	Ta I	4	2707.97	Ru I
2.5	2700.67	Er II	12	2704.37	Re I	3.0	2708.13	Ce II
6	2700.70	Ta I	7	2704.45	Os I	10	2708.18	Os
10	2700.75	Os I	5	2704.54	Nd	15	2708.18	Th II
2.5	2700.80	Yb II	2.0	2704.80	U	5	2708.18	W I
8	2700.89	Au I	3.0	2704.93	Ir I	2.0	2708.19	Tm II
90	2700.94	V II	4	2704.93	Mo II	14	2708.45	Mn II
5	2700.96	Cu II	12 d	2705.19	U	1.6	2708.50	U
4	2700.96	U	6	2705.22	V II	7	2708.57	Fe I
11	2701.00	Mn II	6	2705.24	Mo I	50	2708.58	W I
17	2701.03	Mo I	24	2705.28	Eu II	7	2708.79	Cr II

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50 d	2708.79 W I		6	2712.35 Mo II		9	2716.31 Nb II	
	2708.92 W I		22	2712.41 Ru II		8	2716.32 Th II	
3.0	2708.84 Yb II		24	2712.42 Hf II		10	2716.32 W II	
4	2709.02 Dy II		16	2712.42 Zr II		5	2716.39 U	
3.0 d	2709.03 U		6	2712.48 Re I		3.0	2716.60 Er II	
18	2709.20 Ru I		8	2712.66 Yb II		70	2716.62 Nb II	
42	2709.23 Tl I		12	2712.74 Ir I		6	2716.75 Re I	
6	2709.25 Mo I		8	2713.02 Re I		6	2716.80 Os I	
36	2709.27 Ta II		8	2713.05 V II		70	2716.98 Eu II	
4	2709.30 Ho II		6	2713.13 Pt I		10	2717.16 Mo I	
4	2709.31 Cr II		6	2713.16 Re I		28	2717.18 Ta I	
8	2709.33 Zr I		8	2713.19 Ru I		3.0	2717.28 Ce	
3.0	2709.41 Ce II		5	2713.22 Tb II		5	2717.33 Nb II	
6	2709.51 U		6	2713.25 Er II		36	2717.35 Mo II	
10	2709.58 W II		24	2713.51 Mo II		5	2717.40 Ru I	
850	2709.63 Ge I		18	2713.65 Ho II		1.4	2717.48 Zr I	
10	2709.72 Tm III		16	2713.84 Hf I		6	2717.51 Cr II	
18	2709.86 Os I		4	2713.91 U		6	2717.51 Rh I	
6	2709.96 Mn II		30	2713.94 In I		10	2717.53 W I	
18	2709.99 Eu I		2.0	2714.18 Pr			2717.61 W I	
140	2710.13 Ta I		3.0	2714.20 Nb I		4	2717.55 Tm III	
5	2710.19 Mo II		16	2714.20 V II		3.0	2717.56 U	
4	2710.22 Re I		16	2714.26 Zr II		4	2717.63 Nb II	
160	2710.26 In I		19	2714.41 Fe II		10	2718.04 W II	
10	2710.33 Mn II		6	2714.41 Rh I		24	2718.35 Yb II	
1.0	2710.48 Th II		6	2714.58 U		17	2718.38 Ta I	
9	2710.54 Yb II		3.0	2714.61 Th II		5	2718.43 Cr II	
2.0	2710.55 Fe I		280	2714.64 Os I		10	2718.44 Fe I	
5 h	2710.67 Tl I		300	2714.67 Ta I		7	2718.51 Hf II	
3.0	2710.72 Ta II		3.5	2715.09 Th II		14	2718.54 Rh I	
8	2710.74 Mo I		9	2715.17 Ce II		28	2718.59 Hf I	
5	2710.78 W II			2715.24 Ce		10	2718.71 Os I	
4	2711.10 U		6	2715.17 Mo I		2.5	2718.83 Ru I	
48	2711.35 Sc I		8	2715.31 Rh II		17	2718.90 Sb I	
3.0	2711.46 Th II		4	2715.34 Nb II		260	2718.90 W I	
4	2711.49 Mo II		55	2715.36 Os I		10	2718.91 Os	
11	2711.51 Tm II		120	2715.47 Re I		260	2719.02 Fe I	
32	2711.51 Zr II		4	2715.50 Nb I		130	2719.04 Pt I	
6	2711.53 Er II		50	2715.50 W I		12 d	2719.09 Lu I	
14	2711.58 Mn II		6	2715.54 U II		8	2719.33 U	
8	2711.65 Fe I		14	2715.64 Os I		40	2719.33 W I	
22	2711.74 V II		4	2715.69 Nb I		3.0	2719.45 Th II	
4	2711.76 U		85	2715.69 V II		20	2719.46 Tm III	
3.5	2711.79 Yb II		16	2715.77 Re I		75	2719.52 Ru I	
8	2711.83 Hf I		6	2715.88 Nb II		4	2719.54 Re I	
5	2711.99 Hf II		6 h	2715.91 Lu I		80	2719.65 Ga I	
8	2712.06 U		10	2715.99 Co I		26	2719.86 W I	
10	2712.12 Er II		10	2716.10 Nb I		5	2719.93 Th II	
2.5	2712.14 Hf II		5	2716.18 Cr I		3.0	2719.98 Ce II	
16	2712.31 Cr II		2.5	2716.25 Ti II		4	2720.02 Nb I	

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120	2720.04 Os I		3.5	2724.29 Tb II		4	2728.32 Ho II	
5	2720.14 Rh		320	2724.35 W I		2.0	2728.34 Mo I	
10	2720.17 Mo I		14	2724.41 Mo I		7	2728.55 U	
6	2720.18 Pr		26	2724.63 W I		7	2728.61 Mn II	
4	2720.26 Nb II		6	2724.89 Th II		4	2728.63 Re I	
5	2720.45 Ir I		3.0	2724.95 Ce II		32	2728.64 V II	
5	2720.50 Gd II		8	2724.96 Fe I		7	2728.7 U	
2.5	2720.52 Rh I		50	2725.03 W I		11	2728.70 Mo I	
6	2720.74 Er II			2725.06 W I		5	2728.82 Fe I	
55	2720.76 Ta I		8	2725.07 Ti I		6	2728.83 Ru I	
3.5	2720.89 Tb II		2.0	2725.07 U		4	2728.91 Th II	
120	2720.90 Fe I		22	2725.15 Mo I		13	2728.94 Rh I	
55	2721.19 Tm II		13	2725.42 Ta II		32 h	2728.95 Lu I	
10	2721.56 Ru I		15	2725.47 Ru II		15	2729.04 Tm II	
6	2721.59 Er II		16	2725.47 Zr I		8	2729.10 Hf I	
6	2721.63 Nb II		6	2725.52 U		7	2729.13 Mo I	
3.0	2721.64 Ca I		6	2725.58 La I		2.5	2729.16 Ce II	
20	2721.70 Th II		8	2725.94 U		3.0	2729.26 U	
6	2721.77 Ag I		6	2725.95 Mo I		19	2729.33 Eu II	
4 c	2721.77 Ho II		8	2726.05 Fe I		22	2729.33 Th II	
20	2721.83 Ta I		8	2726.08 Nb I		38	2729.44 Eu II	
80	2721.86 Os I		18	2726.22 Er II		2.5	2729.46 Ru I	
3.0	2721.87 Pr		3.0	2726.32 Ta I		6	2729.51 Dy II	
3.0	2721.90 Tm II		5	2726.49 Pr		3.0	2729.56 Ir I	
70	2721.98 Nb II		3.5	2726.49 Tb II		10	2729.62 W II	
3.0	2722.19 Yb II		3.5	2726.49 Th II		6	2729.64 Re I	
16	2722.21 Re I		90	2726.49 Zr II		17	2729.68 Mo II	
4	2722.31 Nb I		48 h	2726.51 Cr I		4	2729.83 Nb I	
15	2722.38 Th II		3.5	2726.65 Mo I		13	2729.92 Pt I	
20	2722.56 V I		9	2726.70 Hf I		2.5	2730.08 Y I	
6	2722.60 Os		11	2726.97 Mo II		12	2730.10 Er II	
150	2722.61 Zr II		7	2727.02 Zr I		10	2730.20 Mo II	
14	2722.65 Ru I		4	2727.18 Dy II		7 d	2730.21 Tb II	
20 d	2722.68 W I		5	2727.23 Sb I		9	2730.27 Th II	
	2722.81 W II		2.5	2727.25 Th II		10	2730.31 U	
17	2722.70 Re I		5	2727.26 Cr II		8	2730.32 Nb II	
19	2722.75 Cr II		6	2727.34 U		6	2730.33 Ru I	
11	2723.00 Y I		7	2727.42 Ti I		14 d	2730.50 Bi I	
12	2723.03 U		4	2727.43 Nb II		55	2730.61 Os I	
4	2723.22 V II		55	2727.44 Ta II		2.0 d	2730.70 Ce	
1.6	2723.32 Th II		18	2727.54 Fe II			2730.80 Ce II	
10	2723.38 Ce		10	2727.55 Re I		10	2730.71 Hf I	
70	2723.58 Fe I		20	2727.55 Tm III		4	2730.71 Ir I	
5	2723.66 Nb II		420	2727.78 Eu II		3.5	2730.72 Tm II	
2.5	2723.76 Ir I		48	2727.78 Ta I		6	2730.73 Ta II	
9	2723.84 Re I		14	2727.94 Os I		9	2730.74 Fe II	
7	2723.96 Eu I		16	2727.95 W I		4	2730.83 Re I	
9	2723.98 Nb I		6	2728.02 Fe I		13	2730.85 Hf I	
2.0	2724.04 Cr II		5	2728.08 Nb I		10	2730.93 Ru I	
8	2724.06 Ru I		11	2728.27 Os I		7	2731.12 Co I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
2.0	2731.13 Ti I		5	2734.31 Re I		80	2738.76 Hf II	
6	2731.27 U		3.0	2734.35 Nb II		4	2738.79 Ho I	
24	2731.35 V I		34	2734.35 Ru II		2.0	2738.82 Th II	
4	2731.36 Os II		14	2734.42 Th II		4	2738.86 Mn I	
5	2731.37 Eu I		2.5	2734.85 Y II		6	2738.98 U	
7	2731.42 Tm III		160	2734.86 Zr II		18	2739.22 Ru I	
8	2731.53 Er II		7	2734.96 U		24	2739.26 Ta II	
18	2731.56 Re II		8	2735.25 Eu I		26	2739.30 Er II	
3.5	2731.58 Th II		12	2735.26 Ta II		2.5	2739.32 Ir I	
4	2731.58 Ti I		5	2735.29 Ti I		3.0	2739.33 Dy II	
1.2	2731.77 Pr		5	2735.33 Tm II		8	2739.38 Cr I	
32 h	2731.91 Cr I		3.5	2735.45 Tb II		10	2739.39 U II	
3.0	2731.92 Th II		28	2735.48 Fe I		75	2739.55 Fe II	
2.5	2732.04 Ce II		5	2735.58 U		13	2739.71 V II	
10	2732.06 Ta I		4	2735.61 Ti I		8	2739.81 Ti I	
4	2732.17 Ce		3.5	2735.65 Mo I		2.5	2739.87 Sm	
20	2732.21 Re I		200	2735.72 Ru I		11	2739.94 Re I	
3.5	2732.42 Sm I		4	2735.79 Dy I		2.5	2740.00 Ir I	
4	2732.61 Eu I		2.5	2735.83 Th II		8	2740.10 Cr II	
5	2732.67 Ir I		3.0	2735.88 Mo I		2.5	2740.18 Ir I	
4	2732.68 Hf II		5	2735.97 W I		13	2740.18 Nb II	
16	2732.72 Yb II		3.5	2735.99 Tb II		16	2740.32 Os I	
55	2732.72 Zr II		14	2736.24 Tb II		8	2740.35 Zr II	
55	2732.80 Os I		36	2736.25 Ta II		40	2740.43 Ge I	
22	2732.82 Th II		3.0	2736.33 Ce		12	2740.46 Co I	
5	2732.83 Ce		8	2736.39 Os I		1.6	2740.48 Th II	
42	2732.88 Mo II		3.5	2736.42 Mo I		12	2740.51 Zr II	
8	2732.92 Ta I		2.0	2736.44 Th		13	2740.61 Os	
3.0 d	2732.95 U		19 h	2736.47 Cr I		16	2740.62 Eu II	
55	2733.04 Re II		3.0	2736.76 Rh I		3.5	2740.70 Ta II	
2.5	2733.13 Pr		20	2736.96 Mo II		6	2740.72 Dy II	
10	2733.18 W I		10	2736.97 Fe II		12	2740.75 Os I	
1.0	2733.20 Th II		5 d	2737.07 U		9	2740.79 W II	
46	2733.26 Nb II		16	2737.09 Nb II		4	2740.86 U	
16	2733.26 Ti I		70	2737.31 Fe I		2.0	2741.06 U	
3.5	2733.34 Ta II		6	2737.43 Th II		11	2741.07 Cr I	
32	2733.39 Mo I		8	2737.83 Hf I		6	2741.15 Nb I	
12	2733.46 Nb II		2.5	2737.85 Pr		17	2741.17 Ta I	
70	2733.58 Fe I		10 h	2737.88 Mo II		5	2741.20 Li I	
5	2733.59 Ru I		4	2737.89 Zr I		5	2741.32 Mo II	
3.0	2733.77 U		5	2738.00 W I		6	2741.38 Os I	
3.5	2733.90 Tb II		6	2738.13 U		16	2741.55 Zr II	
5	2733.90 V II		5 c	2738.17 Lu II		7	2741.62 Mo II	
20	2733.95 Ho II		8	2738.32 Re I		8	2741.71 Yb II	
180	2733.96 Pt I		5	2738.33 Os I		6	2741.75 Rh I	
22	2733.97 U		4	2738.33 Th II		8	2741.75 U	
3.0	2734.00 Fe I		3.0	2738.41 U		9	2741.96 Ce	
3.0	2734.08 Yb II		6	2738.46 Os I		6	2741.97 Re I	
3.0	2734.27 Fe I		7	2738.48 Pt I		11	2742.03 Cr II	
5	2734.30 Pr		6	2738.60 Mo II		4	2742.10 Pr	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
11	2742.17 Cr I		8	2746.16 U		3.0	2750.13 U	
8	2742.26 Fe I		4	2746.21 Cr II		70	2750.14 Fe I	
7	2742.26 Tb II		5	2746.21 W I		30	2750.18 Er II	
24	2742.32 Ti I		2.0	2746.24 Pr		30	2750.22 Gd II	
55	2742.41 Fe I		3.5	2746.3 U		24	2750.35 Ho II	
12	2742.41 V II		36	2746.30 Mo II		8	2750.41 Ta II	
8	2742.53 Y I		42	2746.48 Fe II		180	2750.48 Yb II	
120	2742.56 Zr II		4	2746.62 Hf I		44	2750.73 Cr II	
5 d	2742.60 U		60	2746.68 Ta I		11	2750.77 Tm II	
4	2742.67 V II		10	2746.74 W I		3.0	2750.88 Fe I	
4	2742.69 Os I		14	2746.83 Ta II		8	2750.89 Ce II	
6 d	2742.74 Re I		30	2746.91 Nb I		6	2750.90 Er II	
	2742.86 Re I		38	2746.98 Fe I, II		8	2751.15 Os I	
3.0	2742.92 Ta I		3.0	2747.15 U		12	2751.45 Yb II	
10	2742.95 Tm II		46	2747.16 Th II		40	2751.47 Mo I	
30	2743.07 Mo I		10	2747.25 Ta I		5	2751.60 Cr I	
16	2743.07 Th II		7	2747.29 Eu II		40	2751.81 Hf II	
28	2743.20 Fe II		6	2747.36 U		32	2751.87 Cr II	
6	2743.22 U		13	2747.44 Re I		9	2752.17 Eu II	
7	2743.28 Eu I		8	2747.48 V II		36	2752.17 Th II	
20	2743.42 W I		2.0	2747.51 Ir I		75	2752.21 Zr II	
9	2743.50 Tb II		1.6	2747.58 Th II		18	2752.30 Ta I	
5	2743.56 Fe I		8	2747.58 Yb II		8	2752.45 Ru II	
24	2743.59 Ta I		7	2747.61 Pt I		48	2752.49 Ta II	
28	2743.64 Cr II		8	2747.83 Eu I		8	2752.77 Ru II	
22	2743.64 Hf I		3.5	2747.85 Ta I		6	2752.78 Hg I	
6	2743.66 U		4	2747.85 Th II		7	2752.85 Re I	
12	2743.71 Mo I		14	2747.91 Os I		12 h	2752.88 Cr I	
8	2743.87 Re I		4	2747.97 Ru II		28	2753.01 Nb I	
8	2743.94 Ru I		2.5	2748.03 Yb II		12	2753.05 Re I	
10	2744.00 Ir I		110	2748.26 Au I		20	2753.05 W	
30	2744.07 Fe I		12 h	2748.29 Cr I		1.6	2753.09 Th II	
20	2744.08 Tm II		10	2748.45 U		11	2753.14 Nb II	
12	2744.26 Eu II		7	2748.49 Mo I		11	2753.18 Tm II	
2.0	2744.27 U		32	2748.66 Yb II		8	2753.29 Fe II	
10	2744.34 W I		140	2748.78 Ta I		19	2753.40 V II	
10	2744.40 U		3.5	2748.81 Th II		10	2753.44 Ru I	
14	2744.45 Ru I		30	2748.85 Nb I		10 h	2753.64 Re II	
6	2744.53 Fe I		80	2748.85 W I		4	2753.69 Fe I	
2.5	2744.66 Pr		12	2748.86 Os I		6	2753.72 Os I	
4	2744.96 Nb II		38	2748.98 Cr II		8	2753.86 Pt I	
44	2745.00 As I		4	2749.06 Ti I		70	2753.88 In I	
10	2745.09 Mo I		12	2749.18 Fe II		4	2754.04 Fe I	
10	2745.10 Co I		12	2749.18 Os I		4	2754.07 Nb I	
9	2745.30 Nb II		60	2749.32 Fe II		28	2754.16 U	
5	2745.38 Mo I		2.0	2749.32 Ir I		240	2754.17 Lu II	
4	2745.61 Eu I		9	2749.53 Th II		4	2754.28 Cr II	
6	2745.72 Ce		1.6	2749.71 Th II		4	2754.29 Mo I	
10	2745.73 Nb II		100	2749.83 Ta I		10	2754.52 Nb II	
75	2745.86 Zr II		6	2749.96 U		650	2754.59 Ge I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
2.5	2754.90 Cr I		60	2758.81 Zr II		10	2761.93 Re I	
20	2754.92 Pt I		13	2758.82 Os I		16	2762.03 Fe I	
10	2754.92 W I		1.6	2758.96 Th II		7	2762.05 Ta II	
22	2754.96 Er II		9	2758.96 U		7	2762.22 Ce II	
8	2755.13 U		9	2758.97 Tm II		2.0	2762.28 Sm	
5	2755.21 Re I		7	2758.98 Cr II		4	2762.31 Ru I	
5	2755.26 W I		3.0	2759.00 Yb II		50	2762.34 W I	
2.5	2755.27 Cr I		8	2759.06 Ta II		85	2762.59 Cr II	
14	2755.29 Nb I		5	2759.32 Ir I		7	2762.69 Hf I	
4	2755.37 Mo I		10 c	2759.35 Ho II		8	2762.70 Mo I	
10	2755.59 Os I		9	2759.39 Cr II		20	2762.85 U	
60	2755.64 Er II		4	2759.41 Th II		3.0	2762.90 Ce II	
12	2755.64 Nb I		17	2759.47 Tb II		8	2763.03 Mo I	
75	2755.74 Fe II		1.4	2759.48 Zr I		10	2763.03 Zr I	
16	2755.75 Dy II		4	2759.56 Tm II		2.5	2763.06 Cr I	
10	2755.94 W I		3.5	2759.58 Mo I		160	2763.09 Pd I	
1.6	2755.96 Th II		5	2759.73 Cr II		5	2763.11 Fe I	
14	2756.07 Mo II		8	2759.79 U		44	2763.27 Os I	
24	2756.26 Fe I		2.0	2759.82 Fe I		8	2763.30 Re I	
	2756.33 Fe I		4	2759.91 Ir I		13	2763.37 Ta II	
3.5 h	2756.45 Zn I		5	2760.03 W I		12	2763.38 Nb I	
15	2756.69 Tm II		16	2760.10 Y I		28	2763.42 Ru I	
2.5	2756.75 Cr I		8	2760.12 V II		28	2763.62 Mo II	
3.0	2756.80 Ce		2.0	2760.33 U		13	2763.62 Th II	
7	2756.91 Hf II		6	2760.39 Pr		19	2763.79 Re I	
4	2757.09 Dy II		11	2760.40 Th II		5	2763.93 Mo I	
17	2757.10 Cr I		2.5	2760.53 Mo II		14	2763.94 Os I	
9	2757.26 Nb II		12	2760.70 V II		40	2764.08 Gd II	
8 h	2757.26 Ta II		5 d	2760.74 W II		2.5	2764.18 Sm	
8	2757.32 Fe I			2760.84 W I		10	2764.19 Co I	
6	2757.40 Ti I		9	2760.78 Yb II		6	2764.25 U	
3.5	2757.41 Tb II		6 h	2760.93 Mn I		50	2764.27 W II	
5	2757.49 Re I		7	2760.96 Tb II		2.0	2764.33 Fe I	
3.5	2757.55 U		8	2761.00 Nb I		9 h	2764.35 Cr I	
40	2757.72 Cr II		14	2761.08 Os I		5	2764.42 Yb II	
4	2757.77 Ho II		1.6	2761.18 U		8	2764.56 Nb II	
16	2757.81 Os I		1.4	2761.29 Ti II		9	2764.64 Th II	
4 d	2757.92 U		5	2761.37 Co I		5	2764.98 Nd I	
	2758.18 U		9	2761.38 Yb II		32	2765.04 Os I	
20	2758.00 Re I		12	2761.42 Ce II		9	2765.12 Th II	
9	2758.08 Ti I		65	2761.42 Os I		10	2765.28 Nb II	
6	2758.23 Ir I		24	2761.53 Mo I		12	2765.40 U	
3.5	2758.31 Hf I		10	2761.59 W II		4	2765.44 Ru II	
120	2758.31 Ta I		50	2761.63 Hf I		6	2765.45 Os I	
8	2758.50 U		50	2761.68 Ta II		11	2765.61 Er II	
42	2758.61 Nb I		10 h	2761.76 Cr I		18	2765.67 V II	
8 d	2758.63 Mo II		15	2761.78 Fe I		50 h	2765.74 Lu I	
5	2758.71 Re I			2761.81 Fe II		5	2765.93 Nb II	
10	2758.78 Hf I		11	2761.78 Sn I		2.5	2766.18 Nb I	
4	2758.78 Nb II		8	2761.91 Zr II		7	2766.22 Co I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
14	2766.26	Mo I	50	2769.98	Er II	6	2773.84	Ho II
8	2766.37	Cu I	16	2770.04	U	12 d	2773.96	Th II
12	2766.38	Er II	10	2770.10	Os I		2774.07	Th II
18	2766.39	Re I	20	2770.17	Gd II	2.0	2774.00	Pt I
8	2766.46	V II	32	2770.42	Re I	100	2774.00	W I
5	2766.51	Dy II	6	2770.46	Hf II	20	2774.02	Hf II
85	2766.54	Cr II	90	2770.71	Os I	11	2774.02	Os I
3.5	2766.57	Tb II	18	2770.82	Th II	19 d	2774.04	Zr I
5	2766.72	Mo I	6 d	2770.86	Zn I		2774.16	Zr II
7	2766.81	Tm II		2770.98	Zn I	12	2774.28	V II
10	2766.85	Ho II	100	2770.88	W I	10	2774.38	Os I
8	2766.88	U	1.8	2770.98	Gd II	24	2774.39	Mo II
2.0	2766.91	Fe I	4	2771.04	Os	4	2774.48	Ru I
18	2766.96	Hf I	11	2771.04	Tm II	100	2774.48	W I
3.0	2767.01	Ce	12	2771.33	Yb II	2.0	2774.58	Ir I
3.5	2767.02	Tb II	1.8	2771.36	Ba II	9	2774.61	Er II
5	2767.09	Tm II	3.5	2771.36	Mo I	6	2774.72	V II
12	2767.12	Os I	10	2771.40	Nb II	3.0	2774.73	Fe I
4	2767.22	Mo I	4	2771.44	Mn I	5	2774.74	U
18	2767.50	Fe II	2.0	2771.45	Cr I	4	2774.77	Sm I
	2767.52	Fe I	18	2771.49	Th II	7	2774.78	Tm II
2.5	2767.54	Cr I	8	2771.51	Rh I	4	2774.85	Th II
2.0	2767.65	Ir I	6	2771.61	Ir I	12	2774.88	Ta I
4	2767.73	Rh I	3.0	2771.65	Nb II	10	2774.90	Os I
28	2767.74	Re I	50	2771.67	Pt I	18	2774.98	Tm II
6	2767.85	Sm	8	2771.83	Ta II	5	2775.02	U
440 d	2767.87	Tl I	1.6	2772.01	Th II	1.8	2775.08	Th II
5	2768.09	Mo I	18	2772.08	Fe I	15	2775.11	Ta II
6	2768.09	Ta II	4 d	2772.18	U	3.5	2775.22	U
36	2768.13	Nb II	5	2772.32	Hf II	6	2775.27	Hf II
3.5	2768.51	Gd II	5	2772.40	Dy II	4	2775.35	Ta II
11	2768.56	V II	24	2772.46	Ir I	4	2775.37	In I
22 d	2768.73	Zr II	26	2772.58	Lu III	220	2775.40	Mo II
	2768.85	Zr II	8	2772.59	U	18	2775.55	Ir I
20	2768.85	Re I	8	2772.60	Dy II	6	2775.76	V II
24	2768.85	Th II	6	2772.60	Ho II	3.5	2775.78	U
10	2768.93	Ru II	10	2772.83	Ho II	90	2775.88	Ta I
26	2768.98	W I	19	2773.02	Hf I	5 d	2775.93	Pr
20	2769.32	Re I	1.6	2773.02	Th II		2776.05	Pr
28	2769.53	Tb II	11	2773.07	Os I	6	2776.11	Sm
2.5	2769.57	Nb II	15	2773.11	Re I	4 h	2776.23	Mn I
5	2769.60	Pr	46	2773.20	Nb I	24	2776.28	Yb II
50	2769.74	W I	3.0	2773.24	Fe I	3.5 d	2776.29	U
30	2769.76	Mo II	4	2773.24	Pt I	20	2776.50	W II
28	2769.81	Gd II	110	2773.36	Hf II	38	2776.69	Mg I
3.0	2769.84	Pt I	6	2773.61	U	5	2776.69	Tm II
15	2769.88	Os I	6	2773.68	V I	3.0	2776.71	Ta II
24	2769.89	Ho II	26	2773.70	W I	28	2776.91	Os I
28 h	2769.92	Cr I	20	2773.78	Mo II	12	2777.04	Tm II
90	2769.95	Sb I	9	2773.80	Tm II	12	2777.10	Ho II

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
6 d	2777.43 Ir I		40	2780.24 Nb II		18	2784.97 Ta II	
	2777.53 Ir I		10	2780.28 W I		6	2784.98 Th II	
9	2777.50 Tm II		9	2780.30 Cr II		50	2784.99 Mo II	
7	2777.71 Re I		12	2780.34 Ta II		32	2785.03 Sn I	
18	2777.73 V II		36	2780.52 Bi I		4	2785.04 Os	
16	2777.74 Mo I		70	2780.70 Cr I		36	2785.07 Tm II	
6	2777.80 Th II		4	2780.70 Th II		2.5	2785.17 U	
8	2777.86 Mo II		9	2780.77 U		14	2785.21 Re I	
3.5	2778.04 Th II		11	2780.87 Tm II		3.5	2785.21 Y II	
5	2778.06 Cr II		3.5	2780.89 Ta		24	2785.22 Ir I	
4	2778.06 Rh I		9	2781.04 U		8	2785.35 Ce	
8	2778.09 Re I		10	2781.18 Er II		3.5	2785.50 Tb II	
15	2778.22 Fe I		38	2781.29 Ir I		3.5	2785.54 V I	
32	2778.29 Mg I		12	2781.37 Ta I		3.0	2785.59 Th II	
11	2778.38 Ru II		38	2781.40 Gd II		1.4	2785.59 Y II	
5	2778.40 Tm II		32	2781.42 Mg I		6	2785.65 Ru I	
3.0	2778.45 U		16	2781.43 Re I		7	2785.69 V I	
7	2778.50 Re I		6	2781.57 Er II		8	2785.70 Cr II	
4	2778.57 Os		8	2781.62 U		4	2785.79 Nd I	
5	2778.69 W II		3.0	2781.79 Ta I		5	2785.88 W I	
6	2778.71 Th II		3.5	2781.84 Fe I		12	2786.11 Er II	
4	2778.76 Gd I		3.0	2781.89 Ce II		4	2786.11 Mo I	
7	2778.82 Co I		48	2781.89 Eu II		5	2786.14 Re I	
4	2778.82 Pr		3.0	2781.99 Ce II		10	2786.17 Tm II	
6	2778.82 Ta II		5	2782.07 U		1.6	2786.24 Th II	
3.0	2778.84 Fe I		4	2782.12 Er II		5	2786.30 Hf II	
5	2778.87 Ho II		3.5	2782.35 Tb II		60	2786.31 Os I	
22	2778.97 Er II		20	2782.36 Nb I		11	2786.56 Re I	
12	2779.10 Ta I		1.6	2782.37 Th II		6	2786.64 Sm	
2.5	2779.14 Cr I		70	2782.55 Os I		7	2786.77 Ta II	
4	2779.14 Gd II		36	2782.97 Mg I		12	2786.80 Os I	
6	2779.23 Sm		3.5	2783.00 Tb II		9	2786.86 Zr I	
8	2779.36 Nb I		10	2783.03 Rh I		6	2786.92 Th II	
44	2779.37 Hf I		10	2783.06 Th II		9	2787.13 Th II	
7	2779.41 U		20	2783.12 W I		5	2787.20 Ho II	
9	2779.48 Mo I		7 d	2783.29 U		7 d	2787.33 U	
6	2779.54 Rh I		5	2783.32 Pr		6	2787.41 Er II	
28	2779.55 Tm II		6	2783.49 Th II		4	2787.63 Cr II	
3.0	2779.57 Dy II		50	2783.57 Re I		3.0	2787.67 Th II	
6	2779.59 Er II		8	2783.69 Hf I		6	2787.68 Gd I	
6	2779.70 Ta I		7	2783.78 V I		46	2787.69 Ta I	
10	2779.72 Nb I		4	2783.88 Os II		18	2787.71 Er II	
20	2779.72 W I		4	2784.06 Th II		22	2787.83 Mo I	
100	2779.81 Sn I		10	2784.27 Ce		12	2787.83 Ru II	
90	2779.83 Mg I		17	2784.45 U II		4	2787.84 Cr I	
4	2780.00 Mn I		14	2784.49 Tb II		5	2787.96 Tm II	
4	2780.01 Ce II		14	2784.66 Yb II		2.5	2787.96 Yb II	
110	2780.04 Mo II		7	2784.67 U		26	2787.98 W I	
8	2780.04 U		3.0	2784.92 U		70	2788.10 Fe I	
140	2780.22 As I		15	2784.95 Er II		6	2788.13 U	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
15	2788.30 Ta I		34	2791.96 Gd II		80	2796.93 Gd II	
3	2788.34 Er II		14	2792.04 Zr I		4	2796.95 Tb II	
5	2788.45 Er II		18	2792.15 Tm II		6	2797.02 Th II	
3.0	2788.68 Th II		10	2792.16 Cr II		9	2797.02 V II	
9	2788.94 Mo I		3.5	2792.50 Pr		3.0	2797.08 Co I	
16	2789.07 W I		6	2792.52 Er III		12	2797.14 U	
3.0	2789.08 Pr		4	2792.64 Ru I		5	2797.20 W I	
6	2789.15 Ta II		100	2792.70 W I		75	2797.26 Tm II	
7	2789.20 Mn I		10	2792.96 Mo I		3.5	2797.30 U	
8 c	2789.27 Re I		17	2793.05 Nb II		40	2797.35 Ir I	
10	2789.38 Sm		5	2793.27 Pt I		9 c	2797.69 Nb II	
11	2789.50 Hf II		6	2793.28 Yb II		120	2797.70 Ir I	
5	2789.68 W I		10	2793.39 Zr I		6	2797.74 Th II	
16	2789.73 Hf II		4	2793.66 Re I		80	2797.76 Ta II	
	2789.80 Hf II		5	2793.85 Er II		3.5	2797.77 U	
6	2789.77 Ta I		6	2793.86 Ta II		8	2797.78 Fe I	
2.0	2789.80 Fe I		5	2793.90 Ho II		5	2797.79 Yb II	
3.0	2790.01 Mo I		7	2793.94 Ge I		10	2797.80 V II	
22	2790.14 Zr I		34	2793.94 U II		30 d	2797.93 Mo I	
12	2790.31 Mo I		22	2793.99 Os I			2798.01 Mo I	
	2790.41 Mo II		22	2794.19 Os I		6	2797.98 Tm II	
8	2790.36 Mn I		1.6	2794.21 Pt II		16	2798.06 Mg II	
4	2790.42 Th II		8	2794.26 Th II		9	2798.10 Re I	
8	2790.53 Ce		12	2794.41 Ho II		28	2798.18 Ir I	
4	2790.57 Nb II		3.5	2794.44 Yb II		14	2798.21 Yb II	
7	2790.66 U		70	2794.60 Tm II		650	2798.27 Mn I	
12	2790.71 Ta I		9	2794.66 Gd II		5	2798.27 Th II	
13	2790.79 Mg II		800	2794.82 Mn I		22	2798.40 Ta I	
6	2790.90 Os I		2.0	2795.01 Fe I		6	2798.56 La II	
13	2790.94 Re I		3.0	2795.08 Yb II		12	2798.65 Ni I	
6	2791.01 Th II		3.5	2795.13 Zr I		2.5	2798.66 Th II	
5	2791.07 U		4	2795.14 Nb II		6	2798.67 Cr II	
5	2791.08 Ho II		6	2795.20 Ta II		11	2798.76 V II	
8	2791.08 Mn I		8	2795.23 U		7	2798.91 Nb II	
2.0	2791.16 Rh I		2.5	2795.31 Yb II		10	2799.03 W II	
1.4	2791.20 Y I		1000	2795.53 Mg II		5	2799.11 Th II	
3.0	2791.26 U		3.0	2795.86 Nb I		5	2799.12 U	
20	2791.29 Re I		10 h	2796.09 Tm II		12	2799.15 Zr II	
16	2791.37 Ta II		2.0	2796.11 Os I		5	2799.36 Nb I	
11	2791.42 Ce		10	2796.15 W I		6	2799.38 Yb II	
3.0	2791.43 Th II		2.0	2796.23 Co I		12	2799.45 V II	
3.0	2791.43 Tm II		80	2796.34 Ta I		3.5	2799.53 Os	
4	2791.44 Dy II		6	2796.46 Ir I		8	2799.54 Er II	
6	2791.51 La II		9	2796.56 Ta I		3.5	2799.73 Er II	
5	2791.54 Mo II		180	2796.63 Lu II		3.0	2799.74 Ir I	
12	2791.62 Tm II		6	2796.63 Rh I		28	2799.84 Mn I	
14	2791.67 Ta I		9 h	2796.70 Sm		50	2799.92 W I	
12	2791.74 Nb II		50	2796.73 Os I		9	2799.99 Ho II	
2.5	2791.79 Fe I		4	2796.78 Mo I		12	2800.05 Yb II	
42	2791.95 W I		18	2796.90 Zr II		3.5	2800.11 Y II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
6	2800.32 Nb I		15	2804.52 Fe I		10	2809.50 Sm	
9	2800.34 Dy II		10	2804.67 W I		14 c	2809.62 Bi I	
10	2800.40 Tm II		6	2804.76 Ta I		65	2809.72 Gd II	
19	2800.51 Tb II		7	2805.24 U		9	2809.95 U	
8	2800.54 Dy II		4	2805.54 V II		4	2809.96 Mo I	
6	2800.57 Ta I		16	2805.63 W I		14 c	2809.99 Ho II	
6	2800.57 Th II		5	2805.70 Ti I		38	2810.03 Ru I	
8	2800.63 Tb II		16	2805.92 W II		12	2810.16 V II	
13 h	2800.75 Re I		8	2806.14 Mn I		3.0	2810.18 Ce II	
8	2800.77 Cr II		50	2806.30 Ta I		12	2810.27 V II	
30	2800.82 Ir I		3.0	2806.50 Ti II		7	2810.30 Ti II	
9 d	2800.87 Zn I		60	2806.58 Ta I		5 d	2810.35 U	
	2801.06 Zn I		9	2806.72 Ho II		3.0	2810.43 Mo I	
20 d	2801.05 W II		4	2806.74 Ru II		190	2810.55 Ru I	
	2801.17 W I		15	2806.75 Er II		2.0	2810.72 Yb II	
480	2801.06 Mn I		10	2806.78 Zr I		11	2810.81 Nb II	
8	2801.40 Dy II		4	2806.79 Tm III		6	2810.85 Dy II	
28	2801.47 Mo I		260	2806.91 Os I		8	2810.86 Sm	
	2801.55 Mo I		16	2806.98 Fe I		20	2810.91 Zr II	
9	2801.93 Os I		26	2807.05 U II		16	2810.92 Ta I	
1000	2801.99 Pb I		6	2807.31 Ho II		14	2810.93 Gd II	
5	2802.06 Pr		4	2807.36 Mo I		3.5	2811.10 Dy II	
3.0	2802.07 Nb I		6	2807.36 Sm		12	2811.34 U	
44	2802.07 Ta I		4	2807.48 Os I		19	2811.36 Ho II	
5 h	2802.25 Re I		5	2807.71 Th		6	2811.43 Dy II	
24	2802.50 Ti I		10	2807.72 W I		4	2811.50 Mo I	
22	2802.53 Er II		50	2807.76 Mo II		2.0	2811.56 Os I	
36	2802.56 U		4	2807.80 Os		6	2811.63 Nb I	
600	2802.70 Mg II		10	2807.83 Th II		8	2811.72 Ta II	
26	2802.75 Tb II		9	2807.86 Re I		22	2811.75 Eu II	
12	2802.80 V II		18	2807.98 Tm II		2.5	2811.87 Ce II	
15	2802.81 Ru I		26	2808.00 Hf II		16	2812.00 Ho II	
190	2802.84 Eu II		7	2808.02 Mn I		9	2812.01 Cr II	
10	2802.88 Er II		6	2808.05 Nb I		5	2812.07 Re I	
10	2802.95 W I		4	2808.16 Zr II		5	2812.25 W II	
3.5	2803.04 Ce		3.0	2808.24 Os I		10	2812.26 Tm II	
7	2803.10 Tm II		9	2808.37 Mo I		3.0	2812.32 Hf I	
14	2803.24 Pt I		5	2808.38 Gd II		7	2812.36 Re I	
11	2803.28 Re II		48	2808.39 La II		1.8	2812.42 Th II	
3.0	2803.37 Th II		17	2808.42 Tm II		3.5	2812.58 Mo II	
16	2803.47 V II		1.0	2808.51 Pt I		12	2812.59 Sn I	
8	2803.55 Er II		8	2808.57 W I		19	2812.64 Tb II	
5	2803.77 Co I		44	2808.94 Os I		3.0	2812.80 Ir I	
9	2803.81 Nb II		18	2808.98 U		6	2812.82 Ru I	
5	2803.83 U		16	2808.99 Th II		8	2812.84 Mn I	
10	2804.01 W I		7	2809.09 Ho II		3.0	2812.98 Ti I	
30	2804.07 Os I		14	2809.11 Mn I		4	2813.02 Tm II	
9	2804.10 Mn I		4	2809.17 Nb II		7	2813.04 U	
16	2804.24 W I		4	2809.17 Ti I		3.0	2813.08 Eu II	
30	2804.37 Er II		26	2809.32 Tb II		5	2813.11 Re I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
5	2813.13	W I	22	2816.39	Dy II	4	2819.78	Tb II
42	2813.29	Fe I	4	2816.55	Tm II	8	2819.80	Ho II
9	2813.47	Mn I	4	2816.68	Nb II	4	2819.83	Er II
60	2813.58	Sn I	2.5	2816.74	U	9	2819.84	U
3.0	2813.64	Y I	9	2816.96	Re I	80	2819.95	Re I
3.0	2813.82	Tm II	44	2817.01	Y III	1.2	2820.01	Co I
40	2813.84	Os I	8	2817.09	Ru I	13	2820.18	Os I
26	2813.86	Hf II	30	2817.10	Ta II	40	2820.19	Er II
340	2813.94	Eu II	1.6	2817.14	Th II	140	2820.22	Hf II
15	2813.96	Re I	6	2817.20	Sm	2.5	2820.22	Tm II
4	2814.01	Gd II	9	2817.31	Tm II	8	2820.27	U
70	2814.20	Os I	3.0	2817.40	Ti I	4	2820.34	Th II
12	2814.31	Ta II	28	2817.44	Mo II	6	2820.42	Hf II
6	2814.32	Th II		2817.50	Mo I	4	2820.47	Er II
14	2814.42	Tm II	5	2817.50	Ce II	9	2820.56	Os I
7	2814.44	Ho II	6	2817.50	Ta I	200	2820.78	Eu II
19	2814.48	Hf II	8	2817.50	V II	6	2820.80	Nb II
14	2814.51	Tm II	2.0	2817.51	Fe I	2.0	2820.96	Sm
9	2814.53	Yb II	4	2817.51	Os I	36	2821.12	U II
4	2814.57	Th II	26	2817.68	Hf I	20	2821.15	Yb II
3.0	2814.67	Mo II	6	2817.84	Ti I	2.5	2821.23	Lu III
20	2814.68	Re I		2817.87	Ti II	18	2821.25	Os I
17	2814.74	Ho II	26	2817.96	U II	20	2821.29	Ni I
3.0	2814.74	Tm II	11	2817.97	Mn I	7	2821.45	Mn I
10	2814.76	Hf II	100	2818.06	W I	6	2821.56	Zr I
11	2814.80	Ta I	11	2818.14	Tm II	3.5	2821.61	Th II
7	2814.81	Ce II	5	2818.25	Pt I	3.0	2821.92	Nb I
4	2814.84	Os I	5	2818.30	Mo I	6	2821.99	Ta I
70	2814.90	Zr I	7	2818.36	Cr II	5	2822.01	Cr II
6	2814.91	Ho II	38	2818.36	Ru I	9	2822.02	Th II
5	2814.96	Ce II	26	2818.47	Tm II	6	2822.03	Mo II
11	2815.01	Ta I	4	2818.48	Tb II	12	2822.03	Ru I
8	2815.02	Mn II	44	2818.74	Zr II	10	2822.12	Re I
11	2815.12	Ta I	5	2818.77	Mn I	3.0	2822.15	Sc II
4	2815.24	Dy II	10	2818.85	Er II	20	2822.37	Cr II
4	2815.27	Os I	2.0	2818.86	Y I	3.0	2822.38	Th II
10	2815.45	W I	16	2818.94	Hf I	4	2822.43	Mo I
4	2815.54	Mo I	4	2818.95	Ru I	7	2822.55	Mn I
8	2815.56	Co I	5	2818.98	U	5	2822.56	Y I
5	2815.76	U	7	2819.08	Tm II	1.8	2822.57	Th II
28	2815.78	Os I	5	2819.14	Ta II	20	2822.57	W II
5	2815.82	Hf I	8	2819.21	Nb I	55	2822.68	Hf II
9	2815.91	Mo I	9	2819.33	Th II	1.8	2822.69	Th II
7	2815.98	U II	2.5	2819.35	Er II	3.0	2822.86	Mo I
5	2816.07	Hf II	11	2819.37	Ta I	2.0	2823.11	Pr
4	2816.07	Th II	2.5	2819.54	Sc II	50	2823.18	Ir I
220	2816.15	Mo II	8	2819.56	Zr I	410	2823.20	Pb I
55	2816.18	Eu II	4	2819.68	Ho II	50	2823.28	Fe I
15	2816.32	Re I	22	2819.74	Hf I	7	2823.36	Ho II
4	2816.35	Yb II	7	2819.78	Re II	4	2823.54	Tm II

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
1.8	2823.55	Th II	11 d	2827.48	Ta II	3.0	2831.36	Ir I
6	2823.73	Ho II		2827.60	Ta II	200	2831.38	W I
2.0	2824.10	Pr	10	2827.50	Zr II	5	2831.44	Mo II
12	2824.17	Os I		2827.54	Zr I	20	2831.55	Tm II
26	2824.20	Ho II	10	2827.52	Re I	2.0	2831.59	Os I
10	2824.25	Re I	10	2827.74	Mo II	24 c	2831.69	Ho II
5	2824.33	Er II	1.8	2827.76	Th II	38	2832.06	U
50	2824.37	Cu I	8	2827.76	Tm II	4	2832.07	Mo II
16	2824.37	U II	22	2827.87	Ru I	12	2832.16	Ti II
90	2824.45	Ir I	60	2827.92	Tm II	2.5	2832.20	Yb II
4	2824.67	Os	4	2827.99	Th II	12	2832.24	Os I
6	2824.77	Tm II	6	2828.07	Ti I	70	2832.31	Th II
5	2824.81	Ta I		2828.15	Ti II	32	2832.44	Fe I
5	2824.86	U	2.0	2828.32	Pr	8	2832.70	Ta II
5	2824.91	Er II	4	2828.37	Dy II	8	2833.03	Tb II
14	2824.97	Yb II	18	2828.58	Ta II	950	2833.06	Pb I
11	2825.18	Nb I	40 cw	2828.72	Eu II	8	2833.24	Ir II
8	2825.35	U	5	2828.79	Mo I	14	2833.26	Eu II
2.5	2825.37	Y II	2.5	2828.81	Fe I	20	2833.28	Hf I
10	2825.44	Dy II	28	2828.90	U	8	2833.31	Ce
9	2825.46	Re I	8	2829.01	Ge I	5	2833.33	Th II
15	2825.56	Fe I	2.0	2829.03	Os I	100	2833.63	W I
60	2825.56	Zr II	44	2829.16	Ru I	20	2833.64	Ta I
3.0	2825.67	Er II	40	2829.27	Os I	26	2833.75	Gd II
6	2825.67	Mo I	12	2829.30	Eu II	5	2833.79	Ho II
3	2825.69	Fe I	9	2829.32	Hf II	7	2833.82	Tm II
3.5	2825.86	Nb II	8	2829.37	U	9	2833.82	U
28	2826.16	Tl I	6	2829.38	Er II	12	2833.91	Zr II
8	2826.18	Ta I	6	2829.75	Nb II	26 d	2833.93	Er II
9	2826.19	U	5	2829.79	Mo I	14	2834.00	Ru I
5	2826.38	Y II	4	2829.79	Ta II	28	2834.08	Re I
4	2826.42	Ta I	7	2829.81	Zr I	6	2834.12	Rh I
12	2826.43	Rh I	32	2829.82	W I	12	2834.13	Hf I
10	2826.43	Tm II	9	2829.94	Mo I	8	2834.26	Cr II
10	2826.48	Nb I	1.8	2829.94	Th II	18 c	2834.35	Lu II
30	2826.54	Mo I	5	2830.15	Tm II	10	2834.39	Mo II
12	2826.64	Ho II	5	2830.17	Ir I	9	2834.40	Zr II
14	2826.68	Rh I	5	2830.29	W I	8	2834.41	Ta I
5	2826.68	Sc II	140	2830.30	Pt I	14	2834.49	Th II
2.5	2826.75	Cr I	5	2830.35	Re I	4	2834.55	U
6	2826.75	Mo I	8	2830.41	Er II	7	2834.71	Pt I
15	2826.86	Th II	6	2830.45	Th II	4	2834.98	Yb II
4	2827.00	U	20	2830.47	Cr II	18	2834.99	Ho II
26	2827.02	Tm II	4	2830.51	Ir I	14	2835.12	Nb II
28	2827.08	Nb II	10	2830.79	Mn I	3.5 d	2835.15	Dy II
16 d	2827.15	W I	22	2830.90	Ce II		2835.33	Dy II
	2827.28	W I	5	2830.92	Ho II	10	2835.33	Mo II
11	2827.18	Ta I	15	2830.94	Sm	3.5	2835.44	Rh I
2.5	2827.31	Rh I	26	2830.98	Yb II	2.5	2835.46	Fe I
9	2827.40	Tb II	4	2831.21	Er II	3.5	2835.60	Ce II

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
280	2835.63 Cr II		3.0	2838.62 U II		4	2842.05 Dy II	
26	2835.64 W I		480	2838.63 Os I		15	2842.09 U	
8	2835.66 Ir I		4	2838.63 Tm II		20	2842.15 Mo II	
6	2835.80 U		38	2838.72 Er II		4	2842.24 U	
10	2835.85 Ho II		9	2838.72 Tb II		12	2842.28 Ir I	
2.5	2835.91 Mo I		6	2838.79 Cr II		8	2842.37 Mo I	
1.2	2836.03 Mo I		5	2838.89 W I		4	2842.42 Tm II	
11	2836.05 Th II		16	2838.93 Tm II		4	2842.48 U	
5	2836.17 Tm II		10	2839.10 Tm II		2.5	2842.52 Ce II	
22	2836.24 Nb I		80	2839.16 Ir I		5	2842.56 W I	
10	2836.25 W I			2839.24 Ir I		2.0	2842.58 Yb II	
3.5	2836.31 Mn I		8 d	2839.24 Th II		42	2842.65 Nb II	
60	2836.40 Ir I			2839.34 Th		3.0	2842.76 Tm II	
4	2836.44 Th I		16	2839.34 W I		30	2842.82 Ta I	
5	2836.48 Cr II		14	2839.34 Zr II		28	2842.82 Th II	
4	2836.49 Zr I		3.0	2839.36 Ce II		1.8	2842.83 Ce	
8	2836.52 V II		7	2839.58 Mo I		20	2843.00 Re I	
4	2836.57 Ru I		7	2839.85 Tm II		2.0	2843.01 Pr	
4	2836.62 Ta I		19	2839.89 U II		8	2843.17 Ru I	
3.0	2836.69 Gd II		1400	2839.99 Sn I		190	2843.25 Cr II	
6	2836.69 Rh I		13	2840.02 Cr II		1.8	2843.30 Th II	
5	2836.70 Ho II		6	2840.15 Th II		6	2843.39 Ho II	
5 h	2836.91 Cd I		60	2840.22 Ir I		8	2843.51 Ta II	
18 c	2836.92 In I		48	2840.23 Gd II		15	2843.52 Zr II	
4	2837.00 Dy II		4	2840.30 Sm		9	2843.63 Fe I	
6	2837.00 Gd II		18	2840.35 Re I		4	2843.64 Nb II	
6	2837.12 Er II		9	2840.39 Ta II		3.0	2843.73 Mo II	
4	2837.15 Co I		2.5	2840.42 Fe I		10	2843.78 W I	
15	2837.19 U		10	2840.44 Os I		8	2843.96 Eu II	
80	2837.23 Zr I		4	2840.47 U		8	2843.96 Tb II	
110	2837.30 Th II		1.8	2840.51 La II		26	2843.98 Fe I	
5 h	2837.32 Mo I		16	2840.54 Ru I		2.0	2844.03 Pr	
12	2837.33 Ir I		8 d	2840.62 U		9	2844.16 Re I	
9	2837.33 U		10	2840.63 Er II		10	2844.18 Ho II	
14	2837.34 W I		16	2840.94 Nb I		75	2844.25 Ta I	
22	2837.42 Os I		8	2841.04 V II		28	2844.39 Mo I	
18	2837.55 Re I		38	2841.15 Nb II		220	2844.40 Os I	
4	2837.61 Dy II		8	2841.16 Th II		4	2844.44 Nb II	
4	2837.73 U		12	2841.33 Gd II		34	2844.46 Ta II	
5	2837.76 W I		12	2841.34 Tm II		75	2844.58 Zr II	
2.5 d	2837.89 Ce II		8	2841.49 Hf I		32	2844.66 Tm II	
	2837.99 Ce II		50	2841.57 W I		9	2844.68 Ho II	
6	2837.90 Mo I		70	2841.60 Os I		8	2844.68 Os I	
6	2837.94 Ta I		4	2841.68 Ru II		20	2844.76 Ta I	
6	2838.02 Zr II		1.8	2841.72 Ce II		4	2844.93 V I	
4	2838.06 V I		1.8	2841.81 Th II		6	2844.99 U	
10	2838.12 Fe I		5	2841.91 Er II		22 h	2845.13 Lu I	
44	2838.17 Os I		18	2841.94 Ti II		1.8	2845.19 Th II	
10	2838.24 Ta II		4	2842.00 Tb II		6	2845.24 V II	
1.2	2838.45 La II		3.5	2842.02 Nb I		34 c	2845.35 Ta I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
6	2845.35	Tm II	3.0	2848.98	Tm II	8	2851.86	Yb II
3.0	2845.45	Ce	3.5	2849.03	Ce II	40	2851.97	Zr II
7	2845.60	Fe I	9	2849.05	Os I	13	2851.98	Nb I
8	2845.60	U	4	2849.05	V II	6	2852.05	Eu II
8	2845.80	Nb II	24	2849.10	Ho II	6	2852.09	U
46	2845.83	Hf I	9	2849.18	V I	6000	2852.13	Mg I
1.8	2845.83	Th II	30	2849.21	Hf II	20	2852.14	Tb II
4	2845.84	Ta I	5	2849.29	Cr I, II	7	2852.36	Ta II
12	2845.87	Er II	4	2849.30	Os I	2.0	2852.50	Th II
8	2845.93	Tb II	3.0	2849.33	Yb II	3.0	2852.59	Tm II
6	2845.96	U	20	2849.38	Mo I	8	2852.75	U
2.5	2846.02	Cr I	20 d	2849.46	W I	8	2852.84	Re I
4	2846.09	U		2849.56	W I	18	2852.87	V I
6	2846.28	Er II	15	2849.48	U	4	2852.89	Ho II
24	2846.28	Nb II	11	2849.56	Nb II	5	2852.91	W I
4	2846.32	Ru I	6	2849.7	U	2.0	2852.94	U
40	2846.39	Os I	280	2849.72	Ir I	1.6	2853.11	Pt I
14	2846.55	Os I	12	2849.82	Ta I	6	2853.22	Cr II
16	2846.57	V I	140	2849.84	Cr II	46	2853.23	Mo II
8	2846.75	Ta I	4	2849.98	U	3.0	2853.25	Tm II
9	2846.97	Re I	3.0	2850.04	Co I	3.0	2853.41	Yb II
4	2847.02	Er II	8	2850.15	Hf II	8	2853.42	U
32 h	2847.17	Yb II	170	2850.49	Ta II	10	2853.49	W I
3.5	2847.24	Nb II	8	2850.49	U	8	2853.57	U II
4	2847.34	U	170	2850.62	Sn I	5	2853.58	Mo I
8	2847.36	Th II	2.0	2850.64	Pr	2.5	2853.68	Yb II
4	2847.49	Sm	15	2850.66	Er II	5	2853.84	W I
200	2847.51	Lu II	10	2850.69	V II	3.5	2853.91	Gd II
14	2847.57	V II		2850.77	V II	4	2853.93	Ti II
2.0	2847.72	U	140	2850.76	Os I	2.5	2854.02	Pr
20	2847.82	W I	8 d	2850.79	Mo I	9	2854.02	Tm II
1.8	2848.02	Th II		2850.90	Mo I	70	2854.07	Ru I
100	2848.03	W I	16	2850.80	W I	8	2854.13	Yb II
17	2848.05	Ta I	4	2850.82	U	4	2854.14	Th II
2.5	2848.05	U	30	2850.96	Hf I	20	2854.16	Tm I
8	2848.08	Er II	24	2850.98	Re I	10	2854.17	Nb I
24	2848.19	Zr II	220	2850.98	Ta I, II	8	2854.17	Tb II
220	2848.23	Mo II	6	2851.04	Tb II	18	2854.34	V II
40	2848.25	Os I	10	2851.10	Ti II	8	2854.43	Y II
10	2848.30	Nb II	7	2851.11	Sb I	8	2854.43	Zr II
26	2848.37	Er II	50	2851.12	Yb II	6	2854.49	Yb II
14	2848.44	Yb II	4	2851.18	Mo I	2.0	2854.58	Pd II
65	2848.52	Ta I	20	2851.21	Hf II	7	2854.67	Ce II
40	2848.52	Zr I	24	2851.26	Th II	5 d	2854.87	Mo I
9	2848.58	Ru I	4	2851.35	Sm	7	2854.88	Ce II
1.6	2848.72	Fe I	14	2851.36	Cr II	6	2854.89	Tm II
9	2848.77	V I	7	2851.43	Th II	2.0	2854.92	Th II
10	2848.86	Tm II	16	2851.45	Nb I	4	2854.92	U
5	2848.92	Er II	38	2851.80	Fe I	8	2854.96	Tb II
5	2848.94	Dy	5	2851.81	U	6	2855.07	Cr II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
26	2855.22 V I		3.5	2859.73 Dy II		10	2862.48 Gd II	
3.5	2855.32 Ce		5	2859.74 U		90	2862.57 Cr II	
12	2855.34 Os I		1.6	2859.78 Gd II		28	2862.57 Eu II	
10	2855.35 W I		60	2859.80 Yb II		4	2862.61 Co I	
24	2855.41 Er II		30	2859.83 Er II		4	2862.61 Er II	
3.5	2855.45 Ce II		14	2859.96 Nb I		5	2862.61 Th II	
100	2855.68 Cr II		24	2859.97 V I		4	2862.62 U II	
8	2855.69 Tb II		20	2860.02 Ru I		10	2862.70 Dy I	
3.5	2855.72 Ce II		10	2860.06 Os I		13	2862.72 Ho II	
3.0 d	2855.82 Ir I		5	2860.07 Re I		4	2862.79 Ce II	
	2855.93 Ir I		20	2860.12 Tm II		3.0	2862.80 U	
5	2855.90 La II		4	2860.17 Dy II		4	2862.84 Mo I	
5	2855.90 Th II		5	2860.25 Re I		22	2862.94 Rh I	
6	2855.96 U		4	2860.26 Er II		3.0	2862.98 La II	
6	2856.00 Mo II		6	2860.31 Hf II		16	2863.01 W I	
80	2856.03 W I		5	2860.36 Tm II		3.0	2863.20 Mo II	
3.0	2856.06 Zr II		8	2860.40 Yb II		1000	2863.33 Sn I	
4	2856.16 Rh I		90	2860.44 As I		10	2863.35 Tm II	
3.0	2856.30 Y II		16	2860.47 U		3.5	2863.37 Os II	
6	2856.42 Dy II		7	2860.55 Tm II		5	2863.44 Fe I	
5	2856.52 Gd II		20	2860.56 Hf I		4	2863.44 U	
8	2856.69 Ta II		5	2860.65 Dy II		4	2863.54 U	
10	2856.77 Cr II		3.0	2860.66 Ir I		15	2863.75 Tm II	
1.2	2857.00 Dy II		4 d	2860.68 Rh I		46	2863.81 Mo II	
3.0	2857.12 Dy II			2860.76 Rh I		8	2863.84 Ir I	
10	2857.13 W I		7	2860.80 U		4	2863.86 Fe I	
12	2857.28 Ta II		11	2860.85 Zr I		16	2863.88 W I	
7	2857.29 Nb I		3.5	2860.87 Ho II		3.0	2863.95 Nd	
8	2857.40 Cr II		7	2860.88 Ta II		6	2864.10 U	
4	2857.47 U		50	2860.93 Cr II		4	2864.26 Os I	
5	2857.49 Th II		140	2860.96 Os I		6	2864.28 U	
5	2857.54 Os I		85	2861.01 Hf II		20	2864.31 Mo I	
6	2857.65 Hf II		36	2861.09 Nb II		15	2864.32 Nb I	
12	2857.68 Tb II		6	2861.12 Ta I		32	2864.36 V I	
1.2	2857.87 Y		7	2861.13 U		5	2864.40 Rh I	
8 h	2857.94 V I		20	2861.21 Yb II		2.5	2864.42 Eu II	
6	2858.01 Ce		9	2861.23 Ho II		4	2864.48 Tb II	
20	2858.04 W I		14	2861.33 Yb II		18	2864.50 Ta I	
3.0 c	2858.14 In I		10	2861.34 Tb II		5	2864.56 Re I	
6	2858.33 Yb II		28 d	2861.34 Th II		6	2864.65 Th II	
26	2858.44 Ta II			2861.42 Th II		18	2864.66 Mo I	
6	2858.46 Yb II		1.8	2861.35 Ce II		3.0	2864.75 Tm I	
12	2858.57 Er II		46	2861.41 Ru I		5	2865.06 Gd II	
12	2858.90 U II		22	2861.49 Ho II		6	2865.10 Zr II	
70	2858.91 Cr II		3.5	2861.62 Ce II		85	2865.11 Cr II	
6	2859.04 Nb II		85	2861.70 Hf II		12	2865.14 U	
14	2859.38 Yb II		20	2861.74 Tm II		9	2865.32 Ta II	
3.0	2859.52 Ce II		42	2861.98 Ta I		6	2865.33 Cr II	
6	2859.57 Mo I		9	2862.32 Ti II		4	2865.50 Ni I	
26	2859.67 Eu II		5	2862.41 U		10	2865.60 Zr II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
15	2865.61 Nb II		18	2869.13 V II		280	2873.32 Pb I	
5	2865.62 Mo II		3.0	2869.22 Er II		32	2873.36 Ta I	
3.0	2865.65 Pr		160	2869.22 Tm II		16	2873.42 Os I	
8	2865.68 Os I		8	2869.31 Fe I		18	2873.48 Cr II	
40	2865.68 U II		8 d	2869.37 U		6	2873.50 Yb I	
80	2866.06 W I		4	2869.39 Os I		30	2873.56 Ta I	
8	2866.09 Sm I		9	2869.56 Mo I		2.5	2873.62 Rh	
8	2866.14 Ta I		6	2869.70 Ir I		5	2873.64 Mo I	
6	2866.16 U		38	2869.81 Zr II		3.0	2873.65 Hf I	
6	2866.28 Dy II		2.0	2869.82 Dy II		15	2873.81 Er II	
3.5	2866.33 Gd II		15	2869.82 Hf II		10	2873.82 Cr II	
3.0	2866.36 Er II		6	2869.92 Th II		6	2873.88 Ho II	
240	2866.37 Hf I		4	2869.96 V II		20	2874.06 Ho II	
5	2866.37 W I		3.5	2870.06 Yb II		9	2874.08 U	
3.0	2866.40 Th II		8	2870.08 Mn II		20	2874.14 Ce	
10	2866.42 V I		3.5	2870.18 Mo I		9	2874.15 Os I	
22	2866.59 V I		48	2870.40 Th II		10	2874.17 Fe I	
2.5	2866.63 Fe I		24	2870.44 Cr II		24	2874.17 Ta I	
60	2866.64 Ru I		3.0	2870.53 Er II		500	2874.24 Ga I	
3.0	2866.65 Th II		28	2870.55 V I		14	2874.43 Ho II	
6	2866.67 Nb I		2.5	2870.81 Th II		14	2874.57 Nb I	
4	2866.69 Ir I		3.5	2870.90 Mo I		4	2874.59 Os I	
28	2866.69 Mo II		5	2870.90 W I		11	2874.81 Er II	
70	2866.74 Cr II		14	2870.97 U		34	2874.96 Os I	
8	2866.79 Ho II		3.5	2871.08 Ce II		200	2874.98 Ru I	
3.0	2866.81 Ce II		4	2871.35 Rh		9	2875.20 U II	
28	2867.05 Yb II		16	2871.37 W I		16	2875.21 W I	
10	2867.10 Cr II		55	2871.42 Ta I		18	2875.28 Re I	
22	2867.19 Re I		220	2871.51 Mo II		2.5	2875.30 Fe I	
12	2867.41 Ta II		2.0	2871.63 Ce II		120	2875.39 Nb II	
5	2867.42 Tb II		12	2871.63 Cr I		28	2875.60 Ir I	
4	2867.59 Os		10	2871.64 Ru I		28	2875.98 Ir I	
5	2867.61 Dy II		9	2871.68 Er II		55	2875.98 Zr I	
2.5	2867.63 Ir I		3.5	2871.75 Gd II		36	2875.99 Cr II	
55	2867.65 Cr II		14	2871.82 Re I		6	2876.06 Eu II	
6	2867.70 Hf I		3.5	2871.89 Mo I		16	2876.11 Ta I	
4	2867.80 U		18	2871.99 Ho II		26	2876.24 Cr II	
16	2868.01 Tm II		5	2872.30 Re I		17	2876.33 Hf II	
28	2868.10 V I		5	2872.32 Tb II		7	2876.41 Dy II	
5	2868.11 Mo II		5	2872.34 Fe I		6	2876.41 Th II	
9	2868.19 Ru I		16	2872.40 Os I		8 d	2876.43 U	
8	2868.19 U		8	2872.44 Ho II		6	2876.54 Mo I	
12	2868.31 Ru I		1.4	2872.50 Co I		40	2876.95 Nb II	
5	2868.32 Mo II		4	2872.53 Zr II		80	2877.03 Nb II	
5	2868.40 Sm		4	2872.55 Tb II		10	2877.05 Ta II	
3.0	2868.45 Th II		4	2872.67 Re I		4	2877.05 U	
75	2868.52 Nb II		6	2872.84 Er II		5	2877.16 Hf I	
36	2868.65 Ta I		11	2872.88 Mo II		8	2877.23 Er II	
4	2868.68 Th II		8	2873.00 Tm II		5	2877.30 Fe I	
5	2868.74 Ti II		4	2873.00 U		18	2877.35 Os I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
17	2877.44	Ti II	15	2880.72	Nb II	6	2884.04	Re I
10	2877.55	Zr II	6	2880.76	Rh I	26	2884.11	Ti II
20	2877.68	Ir I	8 h	2880.77	Cd I	11	2884.18	W I
12	2877.69	Ta II	4	2880.83	Zr I	8	2884.29	Dy II
14	2877.69	V II	11	2880.87	Cr II	28	2884.29	Th II
2.0	2877.83	U	40	2880.98	Ho II	8	2884.41	Os I
14	2877.88	Dy II	6	2881.08	Dy II	7	2884.51	Ru I
140	2877.92	Sb I	3.0	2881.13	Ce II	7	2884.64	Ho II
20	2877.98	Cr II	4	2881.13	Th II	10	2884.64	Re I
4	2878.20	Tm II	3.5	2881.14	Cr I	10	2884.70	Tb II
6	2878.36	Tm II	4	2881.16	Ir I	50	2884.78	V II
5	2878.38	Mo I	2.0	2881.23	Cd I	5	2884.83	Dy II
28	2878.40	Os I	4	2881.23	Ta I	3.0	2884.90	Pr
8	2878.45	Cr II	8	2881.25	Tb II	6 d	2884.92	U
5	2878.54	Er II	5	2881.28	Ru I	10	2884.97	Nb I
9	2878.66	Rh I	40	2881.33	Gd II	32	2885.04	Th II
6	2878.72	Dy II	5	2881.34	Sm	15	2885.14	La II
28	2878.72	W I	260	2881.60	Si I	38 h	2885.14	Lu I
10	2878.74	Nb II	5	2881.62	Pr	4	2885.19	U
10	2878.87	Eu I	6	2881.68	Sm I	4	2885.29	Ce
4	2878.87	U	4	2882.00	Th II	10	2885.40	Ta II
6	2878.90	Er II	5	2882.04	Ho II	6	2885.47	Hf II
28	2879.05	Mo II	4	2882.09	Zr II	9	2885.51	Dy II
8	2879.05	Ta II	6	2882.12	Ru II	11	2885.60	Gd II
6	2879.11	Hf II	3.5	2882.13	Gd II	8	2885.74	Mo I
75	2879.11	W I	3.0	2882.33	Pr	8	2885.90	Tb II
14	2879.16	V II	4	2882.33	Ta II	6	2885.97	Rh I
3.5	2879.19	Th II	4	2882.34	U	4	2885.97	Yb II
3.0	2879.25	Er II	11	2882.37	Rh I	4	2886.05	U
14	2879.27	Cr I	50	2882.50	V II	2.0	2886.06	Os I
6	2879.27	Re I	3.5	2882.51	Th II	8	2886.12	Er II
7	2879.36	Nb II	5	2882.54	Mo I	4	2886.23	Th II
3.5	2879.39	Os II	3.0	2882.60	Er II	10	2886.26	Yb II
75	2879.39	W I	6	2882.61	Ce II	24	2886.29	Tb II
10	2879.41	Ir I	60	2882.64	Ir I	10	2886.44	Co I
10	2879.49	Mn II	20	2882.74	U	8 d	2886.45	U II
7	2879.49	Nb I	5	2882.90	Mn I	14	2886.46	Tm II
4	2879.52	Ta I	5	2882.93	Cu I	11	2886.48	Y I
2.0	2879.53	Th II	10	2882.93	U II	4	2886.50	Os I
10 d	2879.59	U	1.8	2883.04	Tm II	4	2886.50	Th II
14	2879.74	Ta I	4	2883.09	Sm	80	2886.54	Ru I
24	2879.76	Ru I	85	2883.18	Nb II	11	2886.61	Mo I
44	2880.02	Ta I	18	2883.44	Re I	9	2886.68	Mn II
46	2880.03	V II	1.6	2883.45	Au I	19	2887.00	Cr I
3.0	2880.20	Os II	3.0	2883.47	Ho II	10	2887.11	Er II
32	2880.26	Ho II	14	2883.60	Ru I	24	2887.14	Hf I
8	2880.59	U	2.0	2883.61	Th II	19	2887.25	U
5	2880.63	W I	3.5 h	2883.75	U	6	2887.31	Re I
6	2880.64	Ce II	6	2883.80	Zr II	8	2887.44	Tb II
10	2880.65	La II	3.0	2883.94	Os I	11	2887.54	Hf I

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
6	2887.59 U		65	2890.93 Tm II		13	2894.14 U	
3.5	2887.62 Mo I		160	2890.99 Mo II		12	2894.15 Ta I	
11	2887.66 W I		5	2891.03 Dy II		22	2894.17 Cr I	
260	2887.68 Re I		10	2891.04 Ta I		5	2894.22 Ce II	
3.5	2887.69 Nb II		5	2891.07 Ti II		5	2894.25 W I	
1.0	2887.81 Fe I		14	2891.25 Th I		10	2894.32 Re I	
32	2887.81 Th II		12	2891.28 Mo II		6	2894.42 Nb II	
8	2887.85 Eu II		6	2891.29 Ho II		120	2894.45 Mo II	
4	2887.91 U		4	2891.34 Sm		17	2894.47 Tm II	
6 h	2887.96 Tm II		500	2891.38 Yb II		17	2894.48 Tb II	
8	2888.00 Ru I		6	2891.42 Cr I		2.0	2894.48 Th II	
28	2888.03 Yb II		9	2891.48 Re I		8	2894.50 Fe I	
10	2888.04 Zr II		120	2891.64 V II		17	2894.51 U	
12 c	2888.06 Re II		4	2891.65 Ru I		8	2894.58 V I	
5	2888.10 Tb II		14 d	2891.73 Th II		2.0	2894.84 Hf I	
8	2888.15 Mo II			2891.81 Th II		420	2894.84 Lu II	
10	2888.16 Er II		6 d	2891.80 U		4	2894.84 U	
2.5	2888.20 Pt I		5	2891.83 Os I		4	2894.89 U	
19	2888.25 V II		90	2891.84 Ta I		30	2894.99 Ho II	
17	2888.26 U		16	2891.88 Re I		4	2895.04 Fe I	
4	2888.31 Tb II		1.4	2892.03 Ce II		9	2895.06 Os I	
3.5	2888.70 Ce		1.4	2892.15 Ce II		16	2895.10 Ta I	
6	2888.74 Cr II		3.5	2892.17 Th II		11	2895.13 Th II	
8	2888.74 U		14	2892.26 Zr I		8 d	2895.54 U	
4	2888.82 Tb II		8	2892.35 Os I		14	2895.62 Ho II	
42	2888.83 Nb II		7	2892.39 Mn II		4	2895.65 Re I	
6	2888.93 Ti II		70	2892.44 V II		5	2895.93 Er II	
3.0	2889.06 Sm		4	2892.49 Tb II		44	2896.01 Re I	
6	2889.11 Rh I		20	2892.54 Eu I		55	2896.01 W I	
80	2889.29 Cr I		7	2892.56 Hf I		6	2896.03 Tb II	
11	2889.38 Ta I		20	2892.56 Ru I		24	2896.06 Os I	
5	2889.43 Zr II		14	2892.63 Re I		48	2896.21 V II	
8	2889.45 Re I		120	2892.66 V II		4	2896.41 Ta I	
20	2889.58 Mn II		24	2892.81 Mo II		3.5	2896.44 Mo I	
90	2889.62 Hf I		14	2893.03 Eu I		190	2896.45 W I	
50	2889.62 V II		18	2893.07 La II		6	2896.46 Cr II	
50	2889.63 U II		5	2893.12 W I		8	2896.53 Ru I	
10	2889.64 Tm II		2.5	2893.22 Pt I		6	2896.56 Er II	
8	2889.66 Tb II		8	2893.23 Mo I		10	2896.68 U	
6	2889.82 Cr II		42	2893.25 Cr I		7	2896.73 Ce II	
5	2889.84 Mo I		190	2893.32 V II		24	2896.75 Cr I	
6	2889.84 Rh I		5	2893.49 Er II		4	2896.90 Yb II	
5	2889.90 Nb I		10	2893.60 Hg I		3.5	2896.96 U	
3.0	2889.93 Tm II		5	2893.60 Tm II		30	2896.97 Er II	
3.0	2890.17 Ce		6	2893.63 Yb II		3.5	2896.97 Mo I	
9	2890.25 Ta II		4	2893.76 U		6	2897.07 Th I	
5	2890.46 Dy II		36	2893.83 Eu I, II		48	2897.15 Ir I	
3.5	2890.74 Tm II		60	2893.86 Pt I		34	2897.46 Tb II	
9	2890.75 Dy II		15	2893.91 Er II		38	2897.52 Er II	
4	2890.85 Os I		4	2894.09 Ce II		17	2897.63 Mo II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
6 d	2897.67	Cr II	6	2901.78	W I	19	2905.58	Re I
	2897.73	Cr II	6	2901.82	Zr II	3.0	2905.64	Ir I
2.0	2897.69	Y II	2.0	2901.92	Fe I	15	2905.65	Ru I
70	2897.81	Nb II	12	2901.94	Ru I	5	2905.66	Ti I
30	2897.87	Pt I	19	2901.95	Ir I	18	2905.73	Os I
400	2897.98	Bi I	65	2902.05	Ta I	7	2905.83	Ru I
6	2898.01	U	6	2902.10	Ru I	6	2905.90	Pt I
6	2898.1	U	5	2902.19	Ho II	4	2905.93	Th II
3.0	2898.25	Th II	2.5	2902.40	Yb II	10	2905.97	Os
200	2898.26	Hf I	6	2902.41	U	16	2906.02	Re I
4	2898.37	U	75 c	2902.48	Re I	8	2906.06	Mo I
4	2898.42	Ta I	4	2902.81	U II	2.5	2906.12	Th II
10	2898.54	Cr II	3.0	2902.92	Yb II	20	2906.13	V I
6	2898.54	Ru I	20	2903.05	Lu I	3.0	2906.26	Gd II
4	2898.56	U	4	2903.05	U	8	2906.32	Ru I
10	2898.65	Mo I	36	2903.07	Mo II	14	2906.39	Dy II
20	2898.71	As I	6	2903.07	Os I	120	2906.46	V II
15	2898.71	Hf II	2.0	2903.08	Ru I	12	2906.50	Er II
6	2898.71	U II	13	2903.08	Tm II	320	2906.68	Eu II
10	2898.71	Zr II	48	2903.08	V II	32	2906.80	U
3.0	2898.79	Re I	4	2903.16	Th II	3.0	2906.88	Yb II
1.6	2898.82	Y II	1.4	2903.20	Co I	8	2906.91	U
17	2898.84	Tb II	12	2903.21	Os I	4	2907.10	Tb II
30	2899.04	Ta I	7	2903.25	Tb II	10	2907.12	Mo II
12	2899.20	V I	8	2903.45	Er II	7	2907.17	Tm II
9	2899.21	Cr I	6	2903.55	U	13	2907.21	Rh I
60	2899.24	Nb II	14	2903.65	Nb I	5	2907.22	Mn I
4	2899.37	Th I	8	2903.70	V I	15	2907.24	Ir I
4	2899.42	Fe I	3.5	2903.75	Gd I	6	2907.26	W I
6	2899.48	Cr II	3.0	2903.97	Cr II	8	2907.38	Zr II
15	2899.60	V I	5	2904.02	U	3.0	2907.44	Gd II
6	2899.63	Ir I	18	2904.07	Ta I	5	2907.46	Ni I
12	2899.71	Yb II	3.0	2904.09	Tm II	65	2907.47	V II
22	2899.72	Th II	11	2904.13	V I	2.5	2907.52	Fe I
3.0	2899.82	Co I	2.0	2904.26	Th II	3.5	2907.78	Mo I
5	2899.96	Rh I	140	2904.41	Hf I	6 d	2907.88	Sm
10	2900.16	Mn II	6	2904.41	U		2907.99	Sm
300	2900.30	Lu II	100	2904.47	Er II	3.0	2908.03	Os I
20	2900.36	Ta I	10	2904.51	U II	3.0	2908.16	Mo I
2.5	2900.39	Ir I	6	2904.68	Cr I	70	2908.24	Nb II
6	2900.52	W I	8	2904.69	Dy II	11 d	2908.26	W I
7	2900.75	Ta II	100	2904.75	Hf I		2908.40	W I
9	2900.80	Mo II	19	2904.80	Ir I	32	2908.28	U
9	2900.83	Dy II	2.0	2904.81	Rh I	4	2908.32	Yb II
15	2900.84	Ho II	18	2905.23	Zr II	9	2908.34	Re I
5	2901.05	Ta I	20	2905.24	Ta II	7	2908.36	Th II
8	2901.22	U	20	2905.27	Mo I	8	2908.41	U
6	2901.32	Os I	40	2905.31	Gd II	9	2908.42	Ce II
11	2901.54	Tb II	10	2905.41	Tm II	6	2908.44	V II
7	2901.62	Zr II	20	2905.49	Cr I	10	2908.53	Er II

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
6	2908.69	Tm II	5	2911.68	Cr II	50	2914.93	V I
320	2908.82	V II	70	2911.74	Nb II	3.0	2914.94	Ta I
12	2908.88	Nb II	8	2911.80	Tb II	11	2915.11	W I
40	2908.88	Ru I	5	2911.87	Tm II	4	2915.12	Ho II
20	2908.91	Ta I	140	2911.92	Mo II	2.5	2915.23	Cr II
16	2908.99	Eu I	8	2912.01	Th II	6	2915.26	Mo I
30	2909.05	Cr I	42	2912.08	Ti I	20	2915.27	Yb II
900	2909.06	Os I	20	2912.16	Fe I	17	2915.33	Tb II
75	2909.12	Mo II	12	2912.26	Pt I	8	2915.33	V I
11	2909.12	W I	3.0	2912.27	Er II	20	2915.34	Ta I
5	2909.19	Yb II	200	2912.33	Os I	7	2915.38	Mo I
3.5	2909.22	Ru I	6	2912.58	U	7	2915.42	Rh I
8	2909.25	U	6	2912.62	Rh I	2.5	2915.46	Cr II
5	2909.36	Dy II	4	2912.65	Tb II	36	2915.49	Ta I
50 c	2909.41	Ho II	8 d	2912.66	Th II	9 d	2915.54	U
8	2909.47	Yb II		2912.75	Th II	2.5	2915.56	Ce II
20	2909.55	Er II	4	2912.75	U	11	2915.59	W I
5	2909.56	Ir I	4	2912.79	Er II	20	2915.60	Tb II
10	2909.67	Os I	2.5	2912.86	Yb II	26	2915.61	Er II
2.5	2909.72	Dy II	2.5	2912.91	Ce II	15	2915.82	Ho II
2.0	2909.77	Th II	5	2913.08	Gd II	34	2915.99	Zr II
50	2909.82	Re I	6	2913.15	Re I	6 h	2916.02	V I
2.5	2909.89	Dy II	4	2913.17	Ru I	6	2916.10	Mo I
16	2909.91	Hf II	4	2913.32	Ta I	3.0	2916.25	Zr I
3.0	2909.92	Ti II	4	2913.41	Tb II	120	2916.26	Ru I
95	2910.02	V II	6	2913.44	U	13	2916.27	Tb II
5	2910.08	Re I	4	2913.45	Ta II	32	2916.36	Ir I
5	2910.17	Rh II	9	2913.52	Mo I	3.5	2916.37	Th I
10	2910.25	Zr II	12	2913.54	Pt I	2.5	2916.43	Yb II
9	2910.28	Sm II	24 h	2913.54	Sn I	9	2916.46	U
11	2910.30	Tb II	7	2913.73	Cr I	220	2916.48	Hf I
150	2910.36	Er II	2.5	2913.73	Dy II	13	2916.52	Tm II
3.0	2910.36	Tm II	7	2913.81	Mo II	12	2916.64	Zr II
70	2910.39	V II	13	2913.84	Os I	3.5	2916.68	Ce II
5	2910.40	Ho II	28	2913.96	Dy II	6 h	2916.73	Re II
28	2910.48	W I	13	2913.96	Tm II	4	2917.03	Th II
15	2910.53	Gd II	2.0	2914.01	Ni I	10	2917.05	Nb II
100	2910.59	Nb II	6	2914.09	Ho II	4	2917.12	Ta I
18	2910.59	Th II	24	2914.12	Ta I	50	2917.26	Os I
7	2910.82	U	24	2914.21	Yb II	16	2917.37	V II
30	2910.90	Cr I	13	2914.25	U II	14	2917.41	Th II
34	2911.00	W I	4	2914.30	Ru I	3.0	2917.44	Eu II
7	2911.05	Er II	7	2914.30	V I	3.5	2917.49	Hf II
75	2911.06	V II	18 h	2914.60	Mn I	4	2917.56	Ta II
28	2911.14	Cr I	15	2914.63	U II	6	2917.67	W I
8	2911.32	Th II	10	2914.65	Er I	3.0	2917.77	Ru I
3.5	2911.34	Os I	7	2914.71	Os I	5	2917.78	Th II
600	2911.39	Lu II	17	2914.80	Tb II	12	2917.83	Os I
12	2911.52	Yb II	17	2914.83	Tm I	4	2917.90	Th II
4	2911.55	U	4	2914.84	U	8	2917.93	V I

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
8	2918.03	Fe I	18 d	2921.68	U	4	2925.22	U
30	2918.24	Zr II		2921.72	U	4	2925.28	Os I
44	2918.25	W I	7	2921.82	Cr II	10	2925.35	Ho II
22	2918.27	Tm II	5	2921.85	Ho II	24 h	2925.57	Mn I
280	2918.32	Tl I	4	2922.06	U	28	2925.57	Os I
4	2918.37	U	7	2922.09	Tm II	11	2925.57	U
4	2918.52	Gd II	4	2922.11	Ta II	28	2925.65	Tm II
17	2918.57	Ir I	3.0	2922.37	Ce	4	2925.66	Ta I
65	2918.58	Hf I	44	2922.49	Pd I	7	2925.92	Tm II
6	2918.63	W II	2.0	2922.58	Ce II	7	2925.94	Tb II
5	2918.65	Dy II	6	2922.59	Th II	7	2925.98	U
8	2918.67	Ce II	6	2922.60	Ho II	14	2926.09	Ho II
4	2918.68	U	4	2922.79	Th II	4	2926.10	U
2.0	2918.78	Ce II	7	2922.83	Tm II	8	2926.26	V I
15	2918.83	Mo II	8	2922.84	Ta II	4	2926.39	U
4	2918.88	Er II	2.0	2922.99	Th II	12	2926.46	Ta I
6	2918.88	Re I	2.5	2923.10	Rh I	6	2926.59	Fe II
13	2918.89	Tb II	44	2923.10	W I	9	2926.59	U
11	2918.96	Ta II	4	2923.17	U II	70	2926.74	Tm II
7	2918.97	U II	3.5	2923.18	Os	6	2926.93	Re I
7	2919.00	Tb II	8	2923.29	Er II	11	2926.98	W I
18	2919.05	Y I	8	2923.29	Fe I	8	2926.99	Ho II
3.0	2919.20	Mo I	8	2923.32	Gd II	36	2926.99	Zr II
10	2919.28	Er II	160	2923.39	Mo II	7	2927.08	Cr II
7	2919.34	Pt I	11	2923.50	U	5	2927.08	Dy II
40	2919.34	Yb II	28	2923.54	W I	3.0	2927.12	Ru I
7	2919.38	Mo I	95	2923.62	V I	3.0	2927.31	Tm II
9	2919.41	Re I	5	2923.85	Fe I	6	2927.33	Er II
36	2919.59	Hf II	8	2923.85	Zr I	13	2927.38	U II
16	2919.61	Ru I	14	2924.02	Rh I	75 c	2927.42	Re I
26	2919.62	Ho II	320	2924.02	V II	8	2927.54	Mo II
200	2919.79	Os I	2.0	2924.10	Th II	4	2927.54	Ru II
12	2919.83	Th II	13	2924.16	Tb II	5	2927.65	Tm II
28	2919.99	V II	6	2924.23	Yb II	5	2927.67	Co I
8	2920.23	Er II	3.0	2924.25	Gd II	15	2927.72	Er II
4	2920.36	Th II	17	2924.32	Mo II	170	2927.81	Nb II
50	2920.38	V II	10	2924.49	Os I	3.5	2927.85	Yb II
5	2920.69	Fe I	13	2924.53	Tb II	6	2927.93	W I
4	2920.94	Th II	7	2924.58	U	9	2928.15	Cr II
7	2920.98	Tm II	14	2924.60	Re I	11	2928.19	W I
5	2921.07	Os I	20	2924.62	Hf I	11	2928.22	Tm II
8	2921.12	Yb II	220	2924.64	V II	22	2928.25	Th II
10	2921.24	Cr II	5	2924.64	Zr II	16	2928.28	Er II
3.0	2921.26	Nd	320	2924.79	Ir I	11	2928.30	Cr II
6	2921.27	Tm II	85	2925.04	Eu II	26 c	2928.30	Ho II
2.0	2921.36	Th II	22	2925.05	Th II	3.0	2928.34	Gd II
3.0	2921.38	Pt I	28	2925.12	W I	32	2928.34	Ti I
44	2921.52	Tl I	6	2925.19	Ce II	11	2928.44	Er II
14	2921.56	Th II	48	2925.19	Ta I	20	2928.60	U
	2921.62	Th II	11	2925.20	Re I	3.0	2928.64	Tm II

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6	2928.66 W I		9	2931.89 U		7	2935.62 U	
3.5	2928.68 Mn I		10	2931.94 Rh I		6	2935.62 W I	
3.5	2928.70 Th II		5	2932.18 U		15	2935.87 V I	
1.6	2928.75 Mg II		1.6	2932.19 Au		65	2935.99 Tm II	
1.6	2928.81 Co I		6	2932.31 Re I		12	2936.00 W I	
20	2929.01 Fe I		9	2932.32 V II		11	2936.19 Th II	
7	2929.01 Hf I		3.5	2932.43 Er II		5	2936.24 Ho II	
2.5	2929.11 Ce II		4	2932.45 Os I		18	2936.31 Zr II	
10	2929.11 Rh I		7	2932.58 Tm II		6	2936.39 Tb II	
7	2929.12 U		18	2932.61 U		11	2936.45 U	
34	2929.25 Er II		3.0	2932.62 Er II		15	2936.46 Th II	
3.5	2929.28 Th II		110	2932.63 In I		10	2936.50 Mo I	
3.0	2929.44 Cr II		2.5	2932.64 Th II		12	2936.50 Re I	
5	2929.51 Co I		5 h	2932.66 Nb II		3.0	2936.54 Mg II	
34	2929.51 Os I		3.0	2932.70 Cr II		3.0	2936.59 Tm II	
16	2929.53 Re I		36	2932.70 Ta I		6	2936.67 W	
55	2929.63 Hf II		17	2932.91 Tb II		65	2936.68 Ir I	
9	2929.64 U		8	2932.96 Tm I		4	2936.78 U II	
10	2929.72 Er II		140	2933.06 Mn II		2.5	2936.81 Os I	
7	2929.78 U		5	2933.09 Th II		80	2936.90 Fe I	
170	2929.79 Pt I		200	2933.55 Ta I		12	2936.99 Os I	
50	2929.90 Hf I		17	2933.55 Ti I		12	2937.14 W I	
2.0 h	2930.03 Y II		3.0	2933.78 Tm II		3.0	2937.18 Yb II	
6	2930.06 Mo II		8	2933.79 Tb II		14	2937.32 Ti I	
7	2930.13 V II		14	2933.86 U		5	2937.33 Nb II	
10	2930.15 W I		4	2933.89 Tm II		5	2937.35 U	
10	2930.19 Os		6	2933.97 Cr II		6	2937.43 Th II	
8	2930.43 U		4	2933.98 Os I		6	2937.48 Sm II	
140	2930.50 Mo II		3.5	2934.02 Mn I		15	2937.66 Mo I	
5	2930.56 Tm II		5	2934.13 Th II		12	2937.69 V I	
11	2930.57 Os I		100	2934.30 Mo II		80	2937.80 Hf II	
5	2930.59 U		8	2934.31 Dy II		4	2938.00 Ta II	
24	2930.61 Re I		2.0	2934.35 Ce II		14	2938.07 Nb I	
6	2930.63 Ir I		5	2934.35 Yb I		2.5	2938.10 Th II	
12	2930.64 Er II		28	2934.40 V II		4 h	2938.25 V II	
7	2930.77 Mo II		18	2934.52 Dy II		320	2938.30 Bi I	
95	2930.81 V II		8	2934.53 Er II		5	2938.30 Mo II	
4	2930.85 Cr II		18	2934.61 Zr II		4	2938.38 Os I	
4	2930.90 Th II		6	2934.64 Er II		4	2938.43 Ta I	
5	2930.99 Dy II		90	2934.64 Ir I		18	2938.47 Ir I	
4	2930.99 Ta I		24	2934.64 Os I		9	2939.04 U	
6	2931.08 Mo I		6	2934.82 Tb II		17	2939.04 W I	
4	2931.09 Tm I		8	2934.84 Mo I		14	2939.27 Ir I	
48	2931.28 Os I		8	2934.85 Ta I		18	2939.28 Ta I	
8	2931.41 Tb II		85	2934.99 W I		190	2939.30 Mn II	
24	2931.41 U		8	2935.10 Yb II		5	2939.32 Er II	
16	2931.47 Nb II		10	2935.14 Cr II		6	2939.48 Er II	
8	2931.58 Er II		8	2935.20 Mo II		5	2939.49 U	
6	2931.69 Er II		4	2935.29 Nb II		6	2939.52 Yb II	
2.0	2931.83 Sr I		3.0	2935.49 Tm II		3.0	2939.54 Ce	

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9	2939.57 Th II		5	2942.59 Ho II		2.0	2945.95 Th II	
	2939.62 Th II		11	2942.62 Th II		17	2946.12 Nb II	
4	2939.94 Ru I		3.0	2942.76 Pt I		2.5	2946.25 Th II	
4	2940.04 U		7	2942.85 Mo I		6	2946.30 Yb II	
16	2940.05 Tb II		19	2942.85 Os I		6	2946.32 Dy II	
55	2940.06 Ta I		30	2942.85 Th II		4	2946.42 Er II	
12	2940.10 Mo II		11	2942.85 U II		18	2946.42 Mo I	
5	2940.22 Cr II		40	2943.14 Re I		15	2946.53 V I	
140	2940.22 Ta I		200	2943.15 Ir I		6	2946.57 Re I	
6	2940.36 Ru I		5	2943.18 U		22	2946.62 Er II	
22 d	2940.37 U		30	2943.20 V I		18	2946.69 Mo II	
32 h	2940.39 Mn I		7	2943.36 Tm II		2.5	2946.76 Yb II	
	2940.48 Mn I		5	2943.40 U		7	2946.77 Dy II	
6	2940.51 Yb II		5	2943.49 Sm II		10	2946.83 Tm II	
10	2940.54 Ir I		950	2943.64 Ga I		7	2946.84 Cr II	
6 h	2940.58 Th II		4	2943.77 Ta I		8	2946.85 Tb II	
	2940.68 Th II		34	2943.90 U		16	2946.90 Nb II	
220	2940.77 Hf I		40	2943.91 Ni I		18	2946.91 Ta I	
3.5 h	2940.79 Ce II		8	2943.92 Ru I		17	2946.97 Ir I	
6	2940.98 Mo I		3.0	2943.95 Pr		300	2946.98 W I	
8	2940.99 Ho I		10	2944.06 Er II		20	2946.99 Ru I	
8	2941.04 Mn I		150	2944.18 Ga I		11	2947.06 Dy II	
8	2941.05 Dy II		7	2944.19 U		6	2947.13 Hf II	
3.0	2941.08 Ir I		18	2944.21 Mo I		11	2947.22 Dy II	
12	2941.17 Er II		6	2944.32 Re I		12	2947.28 Mo II	
14	2941.22 Mo II		5	2944.35 Ce		6	2947.29 Eu II	
6	2941.24 W I		3.5	2944.40 Fe II		60	2947.38 W I	
13	2941.34 Fe I		300	2944.40 W I		11	2947.43 U	
2.5	2941.34 Th II		26	2944.49 Ho II		3.0	2947.80 Gd II	
9	2941.34 U		10	2944.56 Dy II		80	2947.88 Fe I	
18	2941.37 Ta I		140	2944.57 V II		14	2948.00 Tm II	
120	2941.37 V II		18	2944.71 Hf I		6	2948.01 Gd II	
60	2941.49 V II		3.0	2944.75 Pt I		14	2948.09 U II	
130	2941.54 Nb II		19	2944.82 Mo II		10	2948.15 Tm II	
4	2941.56 Re I		9	2944.91 Tb II		100 h	2948.23 Os I	
7	2941.58 Ta		3.0	2945.04 Ho II		120	2948.26 Ti I	
9	2941.70 Tb II		26	2945.27 Er II		18	2948.30 Dy II	
9	2941.71 Er II		10	2945.43 Mo I		44	2948.40 Y I	
2.0	2941.89 Th II		10	2945.46 Zr II		3.5	2948.43 Fe I	
55	2941.92 U II		18	2945.66 Mo I		4	2948.44 U	
100	2942.00 Ti I		20	2945.67 Ru II		15	2948.80 Er II	
4	2942.04 Yb II		4	2945.69 Ta I		12	2948.94 U	
19	2942.05 Ho II		10	2945.70 Tb II		36	2948.94 Zr II	
2.0 h	2942.11 Mg I		5	2945.83 Ho II		6	2949.04 Tb II	
9	2942.12 U II		16 h	2945.88 Nb II		13	2949.06 Th II	
28	2942.14 Ta I		9	2945.89 U II		11	2949.09 Re I	
14	2942.20 Er II		20	2945.90 Yb II		8	2949.17 V II	
10	2942.20 Os I		32 h	2945.94 Y III		240	2949.20 Mn II	
30 d	2942.33 V I		24	2945.95 Mo II		3.0	2949.22 Er II	
	2942.35 V I			2946.01 Mo I		40	2949.50 Ru I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
130	2949.53 Os I		40	2953.56 Ta I		2.0 c	2957.01 In I	
9	2949.61 U		6	2953.58 Tm II		3.0	2957.05 Tm II	
30	2949.63 V I		5	2953.71 Cr II		9	2957.08 Os	
18 h	2949.73 Lu I		10	2953.71 Dy II		4	2957.32 Tb	
15	2949.76 Ir I		60	2953.94 Fe I		11	2957.33 V I	
20 d	2949.81 Os I		3.0	2954.02 Nb II		32	2957.36 Fe I	
	2949.90 Os I		120	2954.20 Hf I		6	2957.41 Ho II	
6	2949.88 Re I		6	2954.28 Ho II		34	2957.52 V II	
4	2949.92 Ta II		16	2954.33 V I		6	2957.55 Tm II	
8	2949.94 Th II		11	2954.34 Re I		15	2957.58 Th II	
4	2949.97 U		9	2954.39 U II		20	2957.60 Ta I	
8	2950.05 Er II		16	2954.49 Ru I		2.5	2957.63 Yb II	
6	2950.06 Tb II		6	2954.53 Nb II		3.0	2957.67 Tm II	
3.5	2950.08 Tm II		3.0	2954.58 Ti		1.4	2957.68 Co I	
4	2950.30 Ce		16	2954.77 U		4	2957.70 Tb II	
12	2950.32 Dy II		4	2954.88 Th II		7 d	2957.74 U	
4	2950.32 Yb II		12	2954.90 W I		6	2957.75 Dy II	
40	2950.35 V II		6 c	2954.94 Ho II		11 h	2957.75 Mo I	
7	2950.43 Th II		8	2955.00 Os I		4	2957.88 Ta II	
12	2950.50 La II		5	2955.03 Th II		12 h	2957.91 Re II	
140	2950.68 Hf I		5	2955.06 Tm II		8	2957.92 Th II	
12	2950.83 Re I		3.0	2955.27 Ho II		8	2958.00 Ru I	
170	2950.88 Nb II		6	2955.31 Yb II		60	2958.02 Hf I	
6	2951.21 Th II		12 c	2955.32 Ta II		5	2958.10 U	
85	2951.22 Ir I		6	2955.34 Er II		6	2958.14 Th II	
9	2951.24 Er II		2.5	2955.41 Rh I		5	2958.34 Os I	
36	2951.26 Tm II		5	2955.45 Nb I		9	2958.88 Er II	
24	2951.48 Zr II		3.5	2955.60 Ce II		3.0	2958.91 Eu I	
80	2951.69 Lu II		5	2955.60 Er II		2.5	2959.10 Pt I	
5	2951.80 Tm II		3.0	2955.60 Gd II		4	2959.11 Ce	
3.0	2951.90 Hf I		5	2955.60 Th II		3.5	2959.47 Eu II	
60	2951.92 Ta I, II		10	2955.65 U		10	2959.48 Mo I	
5	2951.92 U		4	2955.78 Lu II		18	2959.64 Tm II	
85	2952.08 V II		36	2955.78 Zr II		2.5	2959.71 Ti I	
8	2952.12 Dy II		12	2955.80 V I		3.0	2959.74 Ru I	
11	2952.24 Zr II		12	2955.84 Mo II		10	2959.80 Mo I	
26	2952.29 W II		3.0	2955.85 Th II		10	2959.85 U	
12	2952.34 Os I		10	2955.94 Ce II		2.5	2959.87 Th II	
6	2952.36 Ho II		30	2956.06 Mo II		3.0	2959.97 Nb I	
3.0	2952.43 Gd I		24	2956.06 U		8	2959.99 Fe I	
5	2952.48 Tm II		150	2956.13 Ti I		3.5	2959.99 Ti I	
4	2952.50 Ru I		26	2956.21 Tb II		6	2960.11 Er II	
20 cw	2952.68 Eu II		6	2956.42 Er II		12	2960.14 W I	
5	2952.73 Ho II		2.5	2956.71 Ce II		26	2960.21 Eu II	
12	2952.99 Ta II		7	2956.78 U		12	2960.24 Mo II	
4	2953.03 Dy II		16	2956.80 Ti I		7	2960.58 Tb II	
22 c	2953.11 Ho II		14 c	2956.84 Ta II		6	2960.75 Pt I	
10	2953.19 Sm II		6	2956.89 Nb II		7	2960.82 Hf II	
6	2953.36 Cr II		9	2956.90 Mo II		50	2960.87 Zr I	
6	2953.56 Mo I		8	2956.95 Er II		6	2960.93 Gd II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
28	2961.01 Os I		18	2964.75 Yb II		4	2968.28 Ta II	
24	2961.16 Cu I		9	2964.76 Tb II		80	2968.38 V II	
5	2961.40 Tm II		9	2964.80 Ce II		7	2968.40 U II	
8	2961.69 Ru I		6	2964.88 Er II		6	2968.42 Er II	
6	2961.73 Cr II		160	2964.88 Hf I		3.0	2968.45 Os I	
13	2961.74 Re I		10	2964.92 Th II		6	2968.48 Ru I	
13	2961.80 Hf II		6	2964.96 Mo II		2.5	2968.49 Ir I	
50	2962.15 Os I		40	2964.96 Y I		18	2968.66 Rh I	
24	2962.27 Re I		19	2965.03 U		24	2968.69 Th II	
10	2962.33 Os I		3.5	2965.10 Os		40	2968.76 Er II	
6	2962.37 Dy II		65	2965.11 Re I		80	2968.81 Hf II	
12 h	2962.49 Er II		90	2965.13 Ta II		18	2968.87 Tb II	
9	2962.52 Yb II		60	2965.16 Ru I		9	2968.95 Ru I	
50	2962.68 Zr II		3.5	2965.20 Ir I		50	2968.96 Zr II	
6	2962.74 Sm II		6	2965.21 Er II		8	2968.98 Re II	
55	2962.77 V I		18	2965.26 Fe I		11	2969.02 Sm II	
6	2962.78 Tb II		7	2965.27 Ce II		19	2969.19 Zr I	
10 d	2962.78 U		26	2965.27 Mo II		4	2969.36 Fe I	
6	2962.87 Re I		6	2965.32 Tb II		2.5	2969.38 Th II	
3.5	2962.88 Nd II		7	2965.43 Gd II		40	2969.47 Ta I	
18	2962.89 Mo I		12	2965.48 Nb I		8	2969.48 Fe I	
11	2962.99 Ir I		10	2965.49 Th II		12	2969.50 Tm II	
4	2963.06 Ta I		90	2965.54 Ta I		10	2969.62 W I	
3.0	2963.21 Yb II		18	2965.55 Ru II		36	2969.63 Zr II	
280	2963.32 Lu II		16	2965.71 Ti I		160	2969.82 Lu II	
180	2963.32 Ta I		140	2965.76 Re I		4	2969.82 Th II	
2.0	2963.40 Ru II		8	2965.86 Er II		8	2969.90 Ta I	
6	2963.45 Yb II		28	2965.86 Sc I		15	2970.07 Er II	
4	2963.58 Nd II		44	2965.86 Tm II		34	2970.10 Fe I	
11	2963.60 Gd II		11	2965.92 Ta II		3.5	2970.32 Ce II	
2.5	2963.61 Th II		5	2966.05 Cr II		7	2970.38 Ti I	
6	2963.68 Nb I		7	2966.12 U		5 d	2970.40 Nb II	
15	2963.70 Er II		6	2966.17 Er II			2970.47 Nb II	
6	2963.72 Ru I		12	2966.57 W I		5	2970.48 U	
32	2963.79 Mo II		10	2966.66 U II		280	2970.56 Yb II	
2.5	2963.87 Th II		170	2966.90 Fe I		3.5	2970.69 Os I	
8	2963.90 Er II		70	2966.93 Hf I		70	2970.97 Os I	
14	2963.91 Ta I		6	2967.07 W I		6	2970.98 Er II	
10	2963.97 Tb II		18	2967.22 Ti I		24	2971.06 U	
2.5	2964.00 Th II		16	2967.23 Hf II		55	2971.11 Cr I	
42	2964.06 Os I		8	2967.25 Re I		3.0	2971.11 Pr	
5	2964.11 Th II		120	2967.28 Hg I		5	2971.26 Er II	
6	2964.24 Er II		6	2967.55 W I		4 d	2971.40 Pr	
10	2964.25 U		3.0	2967.58 Pr			2971.45 Pr	
6 c	2964.40 Ho II		55	2967.64 Cr I		10	2971.48 Th II	
150	2964.52 Er II		12	2967.75 Tm II		8 d	2971.59 Er II	
55	2964.52 W I		24	2967.89 U II			2971.71 Er II	
5	2964.62 Os I		8	2967.93 Er II		18	2971.67 W I	
16	2964.63 Dy I		16	2968.04 Re I		24	2971.91 Cr II	
4	2964.73 Dy II		2.5	2968.23 Ti I		9	2971.91 Mo II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
7	2972.22 Th II		12	2975.65 V II		36 c	2979.63 Ho II	
10	2972.25 Os I		22	2975.68 Er II		8	2979.72 Ru I, II	
16	2972.25 V II		6	2975.82 Dy II		90 d	2979.72 W I	
15	2972.27 Er II		100	2975.88 Hf II			2979.86 W I	
5	2972.43 Ho II		12	2975.88 U		22	2979.74 Cr II	
60	2972.57 Nb II		10	2976.02 Th II		8	2979.88 Nb II	
8	2972.58 Ce II		10	2976.10 Ta I		4	2979.95 Er II	
32	2972.61 Mo II		1.0	2976.13 Fe I		8	2979.96 Ru II	
2.5	2972.74 Gd II		16	2976.20 V II		2.5	2980.10 Th I	
18	2972.92 W I		10	2976.26 Ta II		48	2980.15 Gd II	
10	2972.96 Mo I		28	2976.29 Re I		5	2980.28 U	
34	2973.00 Ho II		17	2976.31 U		5	2980.32 Th II	
12	2973.06 Os I		50	2976.52 V II		10	2980.41 Ce	
10	2973.08 U		15	2976.59 Ru II		1.0	2980.54 Fe I	
60	2973.13 Fe I		20	2976.61 Zr II		3.5	2980.55 Y II	
50	2973.22 Tm I		2.5	2976.64 Th II		16 h	2980.63 Cd I	
120	2973.24 Fe I		3.5	2976.72 Cr II		5	2980.64 Ho II	
12	2973.26 U		7	2976.76 Ta I		32	2980.65 Ir I	
12	2973.37 Hf I		12	2976.79 W I		5	2980.69 U	
16	2973.39 Tm II		32	2976.91 Ce II		14	2980.72 Nb II	
10	2973.53 Th II		60	2976.92 Ru I		120	2980.75 Sc I	
15	2973.73 Er II		60	2977.10 W I		40	2980.79 Cr I	
2.0	2973.91 Y II			2977.21 W I		120	2980.81 Hf I	
4	2973.99 Ru I		5	2977.23 Ru II		20	2980.82 Re I	
100	2974.01 Sc I		6	2977.27 Mo I		6	2981.01 Re I	
19	2974.01 Th II		12	2977.27 U		26	2981.02 Zr II	
2.0	2974.03 Rh I		6	2977.30 Re I		5	2981.04 U	
2.0	2974.10 Ir I		8	2977.42 Dy II		7	2981.19 Ta I	
48	2974.10 Nb II		12	2977.46 Ce II		8	2981.20 V II	
4	2974.15 Tb II		32	2977.54 V I		14	2981.33 Th II	
6	2974.22 V I		8	2977.60 Hf II		28	2981.45 Fe I	
11	2974.29 Tm II		42	2977.64 Os I		16	2981.46 Ho II	
3.0	2974.34 Ru I		32	2977.68 Nb II		14	2981.47 Th II	
20	2974.47 Er II		13	2977.68 Rh I		55	2981.48 Tm II	
4	2974.48 Ce		18	2977.78 Tb II		15	2981.52 Mo I	
55	2974.59 Y I		50	2978.05 Zr II		10	2981.64 Nb I	
3.0	2974.60 Tm II		10	2978.14 U		46	2981.65 Ni I	
4	2974.61 Ce II		19	2978.15 Re I		2.5	2981.84 Th II	
3.0	2974.93 Ti I		12	2978.18 Ta II		1.2	2981.85 Fe I	
15	2974.95 Ir I		10	2978.21 Os I		7	2981.91 Ce II	
7	2975.02 Re I		22	2978.28 Mo I		6	2981.94 Ru I	
10	2975.22 U		15	2978.42 Tm II		4	2981.99 Tb II	
5	2975.24 Ho II		9	2978.53 Os I		2.5	2982.02 Th I	
11	2975.25 Re I		20	2978.75 Ta I		30	2982.11 Nb II	
10	2975.34 Os		9	2978.94 Nb II		20	2982.19 Re I	
10	2975.40 Mo II		36	2979.18 Zr II		6	2982.49 Yb II	
55	2975.48 Cr I		17	2979.28 Hf I		7	2982.56 Os	
50	2975.56 Ta I		8	2979.43 Os I		18	2982.61 W I	
3.0	2975.57 Dy II		3.5	2979.43 Tm II		3.0	2982.66 Yb II	
7	2975.64 U		3.5	2979.63 Dy II		24	2982.72 Hf I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
13	2982.74	U II	5	2985.87	Yb II	8	2989.56	Er II
48	2982.90	Os I	8	2985.93	Dy II	36	2989.59	C I
2	2983.02	Th II	170	2986.00	Cr I	6	2989.60	V II
6	2983.04	Mo I	3.0	2986.19	Pr	4	2989.66	Ru I
11	2983.06	Er II	36	2986.20	Rh I	5	2989.78	Dy II
7	2983.13	Tm II	1.2	2986.46	Fe I	24	2989.80	Mo I
6	2983.14	Nb I	240	2986.47	Cr I	4	2989.84	Tb II
14	2983.24	Er II	36	2986.52	Tm II	12	2989.88	U
16	2983.31	Ti I	2.0	2986.67	Ce II	4	2990.21	U
7	2983.43	Sm II	7	2986.77	Th II	3.0	2990.22	Pr
32	2983.49	Os	14	2986.81	Ta II	50	2990.26	Nb II
5	2983.56	Th I	7	2986.99	Rh I	22	2990.27	Ho II
	2983.66	Th	12	2987.03	Tb II	6	2990.36	Yb II
140	2983.57	Fe I	36	2987.16	Co I	5	2990.39	Fe I
4	2983.70	Yb II	12	2987.29	Fe I	19	2990.51	W I
3.0	2983.74	Gd II	13	2987.29	Nb I	65	2990.54	Tm II
26	2983.79	Er II	4	2987.32	Er II	14	2990.62	Ir I
12	2983.80	Th II	4	2987.45	Rh I	6	2990.71	W I
8	2983.81	Mo I	36	2987.64	Ho II	20	2990.87	Ce II
28	2983.98	Yb II	15	2987.65	Si I	3.0	2990.99	As I
6	2984.05	Hf I	2.5	2987.68	Th I	13	2991.05	Th II
7	2984.07	Ho II	7	2987.80	U II	12	2991.25	Ta I
20	2984.13	Ni I	4	2987.80	Zr II	30	2991.33	Eu II
12	2984.14	W I	2.5	2987.88	Dy II	6	2991.35	Dy II
85	2984.26	Y I	14	2987.92	Mo I	8	2991.41	Zr II
7	2984.36	Ta I	4	2987.95	U	3.5	2991.52	Gd II
4	2984.56	Ce II	12	2988.02	V II	4	2991.57	Sm II
22	2984.61	U II	3.0	2988.22	Er II	5	2991.61	Dy II
6	2984.75	Re I	10	2988.23	Mo I	4	2991.62	Ru II
12	2984.78	Fe I	32	2988.23	Th II	8	2991.68	Th II
	2984.83	Fe II	6	2988.26	Os I	3.0	2991.72	Ce
5	2985.02	Pr	12	2988.42	U	9	2991.87	Yb II
8	2985.05	Nb II	20	2988.47	Re I	55	2991.89	Cr I
7	2985.08	Tm II	12	2988.57	Tb II	2.0	2991.90	Ce
4	2985.08	U	22	2988.58	Ta I	12	2991.95	Nb II
13	2985.08	Yb II	75	2988.65	Cr I	9	2991.96	Tb II
6	2985.16	Mo I	20	2988.68	Mo I	14	2992.11	Os I
14	2985.24	Th II	10 d	2988.69	Nb I	160	2992.36	Re I
13	2985.32	Cr II		2988.79	Nb I	4	2992.41	Dy II
13	2985.37	Tm II	3.5	2988.71	Dy II	5	2992.56	Tb II
130	2985.39	Zr I	10	2988.71	U	40	2992.60	Ni I
12	2985.48	Ho II	150	2988.95	Ru I	8 c	2992.71	Ho II
13	2985.50	Er I	28	2988.95	Sc I	17	2992.72	U
12	2985.61	Os I	280	2989.03	Bi I	6	2992.82	Re I
11	2985.80	Ir I	7	2989.05	Ta I	12	2992.84	Mo II
7 d	2985.80	U	10	2989.13	Os I	3.5	2992.88	Tm II
8	2985.82	Ce II	18	2989.19	Cr II	8	2993.04	Gd II
	2985.91	Ce II	120	2989.27	Lu I	5	2993.20	Nd II
6	2985.84	Mo I	14	2989.29	Er II	20	2993.26	Tm II
55	2985.85	Cr I	22	2989.50	Ta I	12	2993.27	Ru I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
70	2993.34	Bi I	13	2997.41	Ir I	13	3002.14	Ce II
6	2993.52	Mo II	3.0	2997.43	Ru I	24	3002.21	Mo I
10	2993.57	Os I	24	2997.65	Os I	10	3002.21	Nb II
50	2993.61	W I	24	2997.79	W I	16	3002.25	Ir I
6	2993.65	Th II	8	2997.89	Er II	22	3002.27	Pt I
7	2993.70	U	180	2997.97	Pt I	6	3002.38	Dy II
14	2993.82	Th II	7	2998.05	Er II	120	3002.39	Er II
12	2993.90	Tm II	8	2998.29	Ho II	16	3002.39	Th II
4	2993.93	Yb II	10	2998.35	Ru I	8	3002.45	Tb II
26	2994.07	Cr I	5	2998.36	U	320	3002.49	Ni I
3.0	2994.10	Er II	4	2998.77	Ce II	3.5	3002.61	Yb II
3.0	2994.33	Tm II	24	2998.79	Cr I	30	3002.64	Er II
9	2994.42	Ce II	12	2999.03	Tb II	5	3002.64	U
120	2994.43	Fe I	7	2999.03	U	55	3002.65	Pd I
5	2994.45	U	100	2999.04	Gd II	15	3002.75	Ce II
80	2994.46	Ni I	16	2999.10	Th II	6	3002.82	W I
11	2994.48	Er I	7	2999.22	U	32	3002.86	Gd II
10	2994.54	V II	6	2999.24	V I	4	3002.98	Ta II
70	2994.73	Nb II	2.5	2999.28	Th II	10	3003.03	Fe I
2.5	2994.73	Nd	8	2999.37	Ta II	10	3003.07	U
24	2994.80	Yb II	3.5	2999.43	Ce II	12	3003.32	U
3.5	2994.96	Ca I		2999.48	Ce II	12	3003.46	V II
50	2994.96	Ru I	36	2999.51	Fe I	16	3003.48	Os I
34	2995.10	Cr I	500	2999.60	Re I	10	3003.56	Ce II
1.6	2995.15	Co I	13	2999.60	Tm II	6	3003.58	Gd II
3.5	2995.22	Eu II	2.0	2999.64	Ca I	44	3003.63	Ir I
30	2995.26	W I	4	2999.80	Th II	180	3003.63	Ni I
8	2995.26	Y I	6	3000.07	Ce II	50	3003.74	Zr II
2.5	2995.27	Th II	7	3000.09	U	8	3003.76	Dy II
15	2995.40	Re I	19	3000.10	Hf II	9	3003.84	Er II
3.5	2995.44	Dy II	4	3000.12	Nb I	5	3003.85	U
4	2995.44	Er II	6	3000.23	Mo I	20	3004.14	Re I
26	2995.64	Ce II	6	3000.24	W I	8	3004.15	Ta I
10	2995.86	Ho II	5	3000.45	Fe I	10	3004.15	U
4	2995.86	Yb II	10	3000.46	Yb II	3.0	3004.17	Tm II
10	2996.00	V II	6	3000.55	Co I	6	3004.34	Re I
14	2996.01	Tb II	6	3000.69	Ho II	9	3004.46	Rh I
22	2996.08	Ir I	2.0	3000.86	Ca I	5	3004.46	Mo II
5	2996.10	U	3.0	3000.87	Ti I	9	3004.58	Tb II
9	2996.37	Er II	120	3000.89	Cr I	9	3004.92	Ta II
1.0	2996.39	Fe I	110	3000.95	Fe I	6	3005.05	Er II
5	2996.39	U	5	3000.95	Th II	85	3005.06	Cr I
80	2996.58	Cr I	32	3001.14	Re I	9	3005.09	Gd II
6	2996.90	Ru I	3.5	3001.16	Tm II	9	3005.10	U
16	2996.94	Y I	34	3001.20	V II	5	3005.14	Nb I
10	2996.99	Th II	5	3001.21	U	6	3005.21	Ir I
5	2997.19	Ir I	13	3001.27	Th II	8	3005.26	Y I
2.5	2997.19	Th II	6	3001.54	Ta I	4	3005.29	Ho II
2.0	2997.31	Ca I	6	3001.64	Ru I	16	3005.37	Zr I
4	2997.36	Cu I	10	3001.98	W I	26	3005.50	Zr I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
14	3005.52	Tb II	4	3009.78	Pd I	5	3013.60	Th II
8	3005.52	U	3.0	3009.90	Ir I	7	3013.61	Tb II
90	3005.56	Hf I	6	3010.12	Tb II	90	3013.71	Cr I
44	3005.76	Yb II	180	3010.13	Gd II	24	3013.71	Tm II
8	3005.77	Nb II	6	3010.26	Mo I	18 h	3013.76	Mo I
2.5	3006.00	Th II	8	3010.29	Er II	6	3013.77	Er II
4	3006.26	Eu II	5	3010.37	U	44	3013.79	W I
6	3006.36	Tm II	5	3010.38	Nb II	3.0	3013.95	Er II
18	3006.42	Re I	24	3010.55	Tb II	6	3014.19	Nd II
5	3006.56	Ta I	9	3010.62	Yb II	8	3014.43	Yb II
48	3006.59	Ru I	5	3010.69	Nb II	10	3014.44	Zr I
7	3006.86	Ca I	7	3010.75	U	19	3014.60	Ho II
8	3006.93	Th II	7	3010.84	Cu I	3.0	3014.62	Er II
4	3007.08	Ho II	14	3010.84	Ta II	44	3014.65	Tm II
6	3007.11	Tb II	7	3010.90	Gd II	5	3014.67	Mn I
3.5	3007.14	Fe I	24	3011.12	Ta I	90	3014.76	Cr I
10	3007.28	Fe I	9	3011.16	Er II	18	3014.82	V II
9	3007.62	Th II	5	3011.16	Mn I	5	3014.88	U
5	3007.66	Mn I	9	3011.24	Hf II	180	3014.92	Cr I
8	3007.80	Th II	5	3011.38	Mn I	3.0	3014.92	Th II
10	3007.90	Os I	5	3011.48	Fe I	10	3015.06	Dy II
15	3007.91	U	5	3011.48	U	90	3015.19	Cr I
5	3007.95	Th II	4	3011.59	Th II	150	3015.30	Tm II
6	3007.97	Nd II	12	3011.69	Ir I	180	3015.36	Sc I
28 c	3008.10	Ho II	130	3011.75	Zr I	12	3015.65	Os I
7	3008.13	Ce II	4	3011.88	Ce II	5	3015.68	U
90	3008.14	Fe I	28	3011.88	Ta I	16	3015.69	Dy II
15	3008.17	Er II	13	3011.92	Re I	6	3015.73	Th II
4	3008.26	Ru I	300	3012.00	Ni I	50	3016.02	Re I
5	3008.27	Th II	5	3012.07	Ho II	4	3016.05	U
13	3008.50	Th II	11	3012.19	Gd II	7 d	3016.09	Tm II
6	3008.61	V II	4	3012.45	U II		3016.18	Tm II
32	3008.79	Ce II	22	3012.47	Er II	10	3016.16	V I
6	3008.80	Ru I	240	3012.54	Ta II	8	3016.18	Fe I
4	3008.83	Dy II	6	3012.70	Th II	24	3016.18	Tb II
12	3008.91	Tm II	7	3012.71	U	10	3016.21	Ho II
24	3009.08	W I	120	3012.90	Hf II	9	3016.37	Ta I
700	3009.14	Sn I	6	3012.92	Ru I	9	3016.43	Ir I
3.0	3009.20	Ca I	18	3013.03	Cr I	8	3016.45	Mn I
3.0	3009.20	Tm II	34	3013.07	Os I	65	3016.47	W I
18	3009.30	Tb II	12	3013.10	V II	30	3016.49	Re I
6	3009.37	Gd II	19	3013.14	Re I	60	3016.78	Hf I
14	3009.39	Yb II	16	3013.32	Zr II	10	3016.78	Mo I
12	3009.42	U	6	3013.36	Ru I	24	3016.78	V II
4	3009.46	Er II	10	3013.37	U	3.5	3016.79	Tm II
14	3009.48	Ho II	16	3013.39	Mo I	22	3016.84	Er II
28	3009.57	Fe I	7	3013.44	U	120	3016.94	Hf II
3.0	3009.65	Gd II	8	3013.46	Pr	12	3016.96	U II
5	3009.70	Er II	7	3013.59	Tm II	13	3016.97	Dy II
5	3009.76	Th II	17	3013.60	Co I	4	3016.97	Re I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
28	3017.10 Tm II		200	3020.54 Lu II		26	3024.92 W I	
6	3017.13 Th II		5	3020.57 U		32	3025.00 Mo I	
10	3017.19 Ti II		280	3020.64 Fe I		24	3025.16 Ta I	
30	3017.20 Ce II		55	3020.67 Cr I		16	3025.29 Hf II	
36	3017.24 Ru I		8	3020.67 Nb I		3.0	3025.43 Th II	
60	3017.25 Os I		10	3020.86 Os		12	3025.61 Dy II	
7	3017.26 Tm II		6	3020.88 Ce II		18	3025.64 Fe I	
20	3017.31 Ir I		34	3020.88 Ru I		8	3025.82 Ir I	
7	3017.35 U		5	3020.92 U		38	3025.84 Fe I	
3.0	3017.37 Hf I		7	3021.01 Sm		28	3025.92 Er II	
95	3017.44 W I		4	3021.04 Ce II		34	3026.06 Tm II	
36	3017.55 Co I		160	3021.07 Fe I		6 c	3026.13 Ho II	
22	3017.55 Yb II		13	3021.22 U		8	3026.15 U	
360	3017.57 Cr I		3.0	3021.47 Th II		28	3026.16 Dy II	
20	3017.63 Fe I		20	3021.50 Hg I		6	3026.37 Co I	
12	3017.73 Er II		360	3021.56 Cr I		5	3026.43 U	
4	3017.73 Ho II		15	3021.73 Y I		18	3026.46 Fe I	
3.0	3017.88 Pt I		12	3021.88 Re I		5	3026.47 Nd	
460	3018.04 Os I		6	3021.95 Tb II		3.0	3026.49 Y II	
6	3018.10 U		3.5	3022.08 Tm II		11	3026.57 Th II	
6	3018.16 Ho II		8	3022.09 Th II		3.0	3026.62 Ce II	
3.0	3018.27 Tm II		3.5	3022.10 Gd II		11	3026.65 Cr II	
110	3018.31 Hf I		3.5	3022.15 Eu I		22	3026.67 Yb II	
6	3018.35 Nd II		26	3022.21 U II		38 d	3026.68 W I	
8	3018.49 Th II		10	3022.28 Y I			3026.78 W I	
55	3018.50 Cr I		6	3022.41 Ir I		8	3026.70 U	
10	3018.59 Tm II		6	3022.71 Er II		8	3027.29 Lu II	
5	3018.59 U		8	3022.74 Nb II		18	3027.33 Tb II	
30	3018.82 Cr I		9	3022.75 Mn I		38 d	3027.51 Ta I	
6	3018.95 Y I		2.5	3022.79 Ce			3027.61 Ta II	
18	3018.98 Fe I		6	3022.99 Re I		6	3027.57 Dy II	
28	3019.14 Ni I		14	3023.14 Ho II		5	3027.58 Tb II	
14	3019.17 Tb II		5	3023.43 Ce II		160	3027.60 Gd II	
10	3019.23 Ir I			3023.49 Ce II		2.0	3027.63 Ce II	
220	3019.34 Sc I		11	3023.43 Tb II		10	3027.66 U I	
2.0	3019.37 Ru I		8	3023.70 Tb II		12	3027.77 Mo II	
50	3019.38 Os I		10	3023.91 Rh I		130	3027.91 Pd I	
8	3019.41 Th II		26	3024.03 Fe I		80	3028.04 Zr II	
4	3019.54 Rh I		12	3024.09 Ta I		10	3028.18 Ho II	
8	3019.67 Ta I		140	3024.35 Cr I		13	3028.19 U	
10	3019.76 Er II		11 c	3024.38 Ho II		26	3028.28 Er II	
6	3019.79 Tm II		7	3024.38 U		4	3028.43 Rh I	
26	3019.84 Zr II		13	3024.50 W II		42	3028.44 Nb II	
6	3020.01 Ir I		13	3024.51 U		9	3028.57 Th II	
5	3020.24 U		3.0	3024.57 Ce		5	3028.73 Tm II	
18	3020.29 Tb II		9	3024.60 Hf I		12	3028.78 Ta I	
5	3020.33 Er II		240	3024.64 Bi I		5	3028.96 Ce II	
55	3020.47 Zr II		3.0	3024.68 Th II		10	3028.98 Gd II	
60	3020.49 Fe I		17	3024.74 Nb II		9	3029.13 U	
130	3020.53 Hf I		9	3024.76 Hf II		22	3029.16 Cr I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
32	3029.20	Au I	9	3032.83	Tb II	17	3037.73	Ce II
9	3029.23	Tb II	180	3032.84	Gd II	7	3037.75	Ir I
5	3029.28	Pr	8	3032.85	As I	140	3037.94	Ni I
28	3029.36	Ir I	3.5	3032.93	Cr II	10	3037.96	Re I
5	3029.42	U	6	3033.12	Ce II	3.5	3037.99	Yb II
140	3029.52	Zr I	7	3033.18	Dy II	8	3038.05	U
12	3029.73	Ti II	20	3033.19	U II	6	3038.18	Ru I
4	3029.74	Nb II	11	3033.44	Ho II	44	3038.29	Dy II
15	3029.83	Dy II	26	3033.45	Ru I	6	3038.60	Th II
50	3029.83	Sb I	36	3033.45	V II	9	3038.66	Tb II
19	3030.15	Fe I	20	3033.58	W I	24	3038.69	Ho II
90	3030.24	Cr I	3.0	3033.62	Ir I	3.0	3038.98	Nd II
14	3030.29	Ta I	38	3033.82	V II	750	3039.06	Ge I
14	3030.31	Ce II	140	3034.05	Gd II	7	3039.13	Sm II
8	3030.41	Dy II	7	3034.06	Ru I	8	3039.14	U
38	3030.45	Re I	26	3034.06	Th II	24	3039.26	Ir I
3.0	3030.48	Th I	7	3034.08	Tm II	10	3039.26	U
4	3030.65	Gd II	850	3034.12	Sn I	20	3039.31	W I
120	3030.70	Os I	8	3034.12	Tb II	800 c	3039.36	In I
30	3030.76	Sc I	50	3034.19	Cr I	4	3039.41	Nb II
5	3030.83	U	20	3034.20	W I	3.5	3039.51	Ce II
3.0	3030.86	Th II	3.0	3034.43	Co I	8	3039.67	Yb II
28	3030.92	Zr II	13	3034.55	Re I	8	3039.68	Nb I
12	3031.01	Os I	8	3034.64	Yb II	10	3039.78	Cr I
9	3031.01	V I	10	3034.84	Sm II	6	3039.82	Mo I
7	3031.06	Mn II	6	3034.87	Bi I	5	3039.82	Nb II
130	3031.11	Yb II	9	3034.91	Tb II	2.5	3039.93	Sc II
46	3031.16	Hf II	12	3035.11	Th II	4	3039.93	U
6	3031.18	Dy II	6	3035.33	Mo I	13	3040.03	Re I
6 d	3031.19	Th II	6	3035.47	Ru I	5	3040.05	Th II
	3031.28	Th I	9	3035.51	U	20	3040.31	Ru I
19	3031.22	Fe I	3.0	3035.53	Th II	5	3040.34	Gd II
6	3031.27	Re I	15	3035.65	Ho II	17	3040.43	Fe I
8	3031.30	Os I	5	3035.96	U	4	3040.47	Ir I
36	3031.31	Er II	8	3035.98	Tm II	5	3040.5	U
18	3031.35	Cr I	6	3036.10	Cu I	12	3040.60	Mn I
24	3031.60	Tb II	30	3036.21	Er	5	3040.70	Ta II
19	3031.64	Fe I	13	3036.31	Mo I	3.0	3040.77	Eu II
7	3031.67	Tm II	55 d	3036.39	Zr II	70	3040.85	Cr I
3.0	3031.70	Th II		3036.50	Zr II		3040.91	Cr II
10	3031.87	Ni I	13	3036.45	Pt I	300	3040.90	Os I
26	3031.99	U II	8	3036.45	U	10	3040.98	Ta I
5	3032.00	Th I	6	3036.55	Re I	10	3041.00	Re I
5	3032.41	Ir I	3.5	3036.59	Y II	5	3041.25	U
2.5	3032.69	Pr	5	3036.61	U	6	3041.42	V II
3.0	3032.73	Ce II	9	3036.70	Dy II	7	3041.64	Fe I
36	3032.77	Nb II	70	3037.04	Cr I	38	3041.70	Mo I
6	3032.79	Re I	5	3037.04	Tb II	7	3041.74	Cr II
40	3032.80	Sn I	95	3037.39	Fe I	12	3041.74	Fe I
10	3032.81	Os I	14	3037.50	Ta II	55 d	3041.74	W I

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
	3041.87 W I		5	3044.84 Y I		11	3048.78 Ru I	
4	3041.86 U		16	3044.91 Os I		16	3048.81 Tm II	
4	3041.9 U		30	3044.94 V I		5	3048.86 Mn I	
6	3041.99 Re I		24	3044.97 Tb II		24	3048.86 Ta I	
6	3042.02 Fe I		12	3045.01 Ni I		22	3048.89 Co I	
38	3042.06 Ta II		5	3045.21 Pr		12	3048.89 V II	
5	3042.07 Tb II		6	3045.32 Os		10	3049.00 W I	
3.5	3042.08 Dy II		22	3045.37 Y I		10	3049.04 Os I	
12	3042.26 V II		4	3045.46 U		30	3049.09 Th II	
6	3042.29 Re		9	3045.55 Th II		11	3049.14 Dy II	
26	3042.35 Tm II		15	3045.59 Mn I		5	3049.18 Er II	
14	3042.44 Ta II		11	3045.71 Ru I		2.0	3049.21 Pr	
11	3042.48 Co I		6	3045.72 Sc II		9	3049.29 Er II	
22	3042.48 Ru I		2.5	3045.77 Rh I		9	3049.29 Hf I	
5	3042.50 Tb II		16	3045.83 Zr I		11	3049.33 Zr I	
80	3042.64 Pt I		14	3045.96 Ta I		42 c	3049.38 Ho II	
2.5	3042.65 Ir II		12	3046.08 Hf II		22	3049.44 Ir I	
11	3042.65 Yb II		4	3046.38 Dy II		24	3049.46 Os I	
19	3042.66 Fe I		6	3046.44 Ho II		70	3049.56 Ta I	
3.5	3042.73 Mn I		55	3046.45 W I		6	3049.64 Th II	
4	3042.73 U		8	3046.46 U II		100	3049.69 W I	
12	3042.74 Os II		14	3046.48 Gd I		4	3049.84 U	
6	3042.83 Ru I		6	3046.48 Yb II		3.0	3049.86 Th II	
4	3042.83 Tb II		8	3046.57 U		7	3049.98 Er II	
11	3043.01 Gd I		9	3046.68 Ti II		14	3050.10 Ta I	
9	3043.06 Th II		5	3046.71 Ce II		14	3050.14 Cr II	
30	3043.12 V I		2.5	3046.76 Rh I		24	3050.20 U	
20	3043.15 Dy II		32 d	3046.76 Tm II		22	3050.39 Os I	
5	3043.25 Zr I			3046.87 Tm I		6	3050.40 V I	
3.0	3043.29 Nd		4	3046.77 Pr		5	3050.57 Tb II	
11	3043.36 Mn I		19	3046.80 Mo I		3.0	3050.59 Ce	
12	3043.45 Dy II		8	3046.84 U		14	3050.73 Ho II	
22	3043.50 Os I		8	3046.93 Sm II		30	3050.73 Tm II	
30	3043.56 V I		12	3046.95 Th II		80	3050.76 Hf I	
12	3043.64 Os I		5	3047.00 Tb II		3.0	3050.80 Sm II	
10	3043.65 Tb II		26	3047.04 Mn I		280	3050.82 Ni I	
8	3043.79 U		5	3047.06 Yb II		7	3050.84 Er II	
34	3043.81 W I		2.5	3047.11 Y I		22	3050.89 V I	
10	3043.92 Ta I		22	3047.16 Ir I		6	3050.98 Th II	
160	3044.00 Co I		24	3047.25 Re I		3.0	3051.11 Nd II	
3.0	3044.01 Yb II		26	3047.31 Mo I		20	3051.12 Tb II	
6	3044.07 Os I		10	3047.57 U		10	3051.14 U	
10	3044.08 Re I		15	3047.60 Dy II		12	3051.17 Os I	
20	3044.16 U		130	3047.60 Fe I		13	3051.46 Dy II	
3.5	3044.40 Ce II		18	3048.10 Nb I		6	3051.78 Th II	
8	3044.40 Ho II		30	3048.22 V II		16	3051.98 Ce II	
6	3044.41 Os I		7	3048.41 Er II		5	3052.15 Nd II	
5	3044.56 Dy II		6	3048.50 Ru I		3.0	3052.16 Ir I	
42	3044.57 Mn I		12	3048.64 U I		10	3052.18 Tb II	
12	3044.76 Nb II		14	3048.66 W I		9	3052.19 V I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
13	3052.32	Dy II	14	3057.22	Ta II	10	3061.61	Re I
10	3052.91	U	11	3057.22	Zr II	19	3061.62	U
7	3052.93	Sc II	22	3057.28	Ir I	14	3061.69	Er II
13	3053.09	Nb I	11	3057.40	Ti II	16	3061.69	Th II
14	3053.24	Tb II	65	3057.45	Fe I	5	3061.80	Tb II
8	3053.26	Pr	44 c	3057.45	Ho II	90	3061.82	Co I
24	3053.39	V II	3.0	3057.63	Th II	4	3062.06	Pr
48	3053.55	Tb II	150	3057.64	Ni I	7	3062.06	Tm II
24	3053.57	Gd II	9	3057.66	Re I	18	3062.12	Mn I
6	3053.60	Ir I	2.0	3057.89	Rh I	8	3062.19	Dy II
10	3053.63	Re I	2.0	3057.89	Th II	60	3062.19	Os I
60	3053.65	V I	9	3057.90	Lu III	2.5	3062.20	Co I
7	3053.71	Tm II	26	3057.91	U	10 c	3062.53	Ho II
7	3053.77	Er II	14	3058.09	Ti II	26	3062.54	U
90	3053.88	Cr I	7	3058.35	Tm II	28	3062.62	Dy II
9	3053.89	V II	6	3058.42	Th II	14	3062.78	Tb II
36 c	3054.00	Ho II	3.5	3058.55	Ce II	55	3063.01	Ce II
7	3054.01	W I	19	3058.64	Ta I	16 d	3063.03	Th II
14	3054.04	Tm II	900	3058.66	Os I		3063.10	Th II
120	3054.32	Ni I	20	3058.78	Re I	6	3063.13	Yb II
32	3054.36	Mn I	12	3058.98	Eu I	7	3063.14	Ho II
20	3054.41	Er II	7	3058.98	Tm II	19	3063.25	V II
9	3054.52	Hf II	100	3059.09	Fe I	4	3063.41	Cu I
5	3054.73	U	6	3059.48	Dy II	24	3063.56	Ta I
110	3054.84	Zr II	3.0	3059.52	Cr II	11	3063.57	Zr I
11 c	3054.87	Ho II	2.0	3059.74	Ce II	8	3063.66	Pr
13	3054.90	Re I	7	3059.74	Ti II	3.0	3063.67	Yb II
32 cw	3054.94	Eu II	9	3059.92	Gd I	14	3063.78	Hf I
15	3054.94	Ru I	8	3060.00	Dy II	9	3063.79	Nb II
10	3054.97	Os I	6	3060.05	Co I	5	3063.88	Ta I
16	3055.21	Os I	5	3060.06	U	4	3063.88	U II
7	3055.22	Y II	16	3060.11	Zr II	7	3064.01	Tm II
28	3055.24	Ce II	13	3060.18	Th II	78	3064.09	Tb II
6	3055.26	Fe I	6	3060.24	Ho II	4	3064.18	U
26	3055.32	Mo I	19	3060.29	Ta I	16	3064.19	Ho II
5	3055.44	Hf II	30	3060.30	Os I	100	3064.28	Mo I
12	3055.52	Nb II	13	3060.32	Re I	3.5	3064.37	Co I
10	3055.59	U II	6	3060.44	Th I	4	3064.51	Ir I
32	3056.07	Tm II	190	3060.46	V I	5	3064.51	Tb II
10 h	3056.31	Sc	20	3060.65	Dy II	26	3064.53	Nb II
160	3056.33	V I	13	3060.78	Mo II	7	3064.60	Re I
9	3056.62	Nb I	4	3061.11	Nb I	40	3064.62	Ni I
10	3056.62	Ta II	7	3061.14	Tm II	16	3064.63	Zr II
9	3056.71	Nd II	4	3061.24	Nb I	14	3064.68	Hf II
140	3056.72	Lu II	5	3061.28	Er II	320	3064.71	Pt I
8	3056.72	U	14	3061.35	Zr II	6	3064.84	Er II
11	3056.74	Ti II	9	3061.37	Dy II	40	3064.84	Ru I
26	3056.78	Ce II	5	3061.41	Ir I	14	3064.94	W I
7	3056.97	Dy II	6	3061.51	Dy II	7	3064.97	Er II
120	3057.02	Hf I	20	3061.59	Mo I	32	3065.04	Mo II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
16	3065.04 Yb II		6	3069.42 Gd I		60	3073.34 Er II	
11	3065.07 Cr I		7	3069.64 Ce II		9	3073.34 Ru I	
11	3065.11 Sc II		18	3069.64 V I		8	3073.39 Ta I	
5 h	3065.17 Tb II		13	3069.68 Nb II		14	3073.49 Tm II	
8	3065.21 Zr II		19	3069.71 Ir I		8	3073.50 U	
9	3065.26 Nb II		8	3069.73 Nd II		20	3073.55 Dy II	
95 *	3065.31 Pd I		22	3069.94 Os I		11	3073.68 Cr I	
11	3065.69 Tb II		32	3069.94 Re I		22	3073.82 V I	
6	3065.78 Sm II		48	3070.05 Tb II		7	3073.84 Tm II	
8	3065.87 Tb II		22	3070.27 Mn I		38	3074.08 Os I	
6	3065.93 Th II		6	3070.44 Dy II		19	3074.10 Hf I	
22	3066.02 Mn I		44	3070.75 Er II		20	3074.30 Ho II	
4	3066.10 Nb II		19	3070.82 Th II		100	3074.37 Mo I	
8	3066.12 Os I		32	3070.90 Mo I		2.5	3074.56 Pr	
110 d	3066.22 Ti II		12	3070.90 Nb II		6	3074.71 Tb II	
	3066.35 Ti II		6	3071.11 Ce II		28	3074.79 Hf I	
22	3066.23 Er II		26	3071.16 Re I		30	3074.96 Os I	
320	3066.38 V I		4	3071.18 Nb II		11	3075.04 U	
3.0	3066.41 Th II		6	3071.24 Ti II		4	3075.19 Dy II	
5	3066.87 U		8	3071.29 Sm II		130	3075.22 Ti II	
16	3066.99 Dy II		4 d	3071.43 Nd II		13	3075.27 V I	
60	3067.01 Ge I			3071.50 Nd II		3.0	3075.30 Hf I	
26	3067.12 V II		11	3071.44 Mo I		10	3075.38 Nd II	
3.5	3067.16 Cr II		13	3071.56 Nb II		5	3075.45 U	
24	3067.20 Tb II		18	3071.58 Ba I		9	3075.53 Ho II	
40	3067.24 Fe I		7	3071.62 Ce II		34	3075.72 Fe I	
5	3067.30 Rh I		24	3071.92 Dy II		2.0	3075.83 Th II	
160	3067.40 Re I		3.0	3071.94 Pt I		26	3075.90 Zn I	
95	3067.41 Hf I		10 h	3072.06 Zn I		2.5	3076.02 Yb II	
10	3067.54 Sm		26	3072.11 Th II		10	3076.04 Tb II	
3600 c	3067.72 Bi I		50	3072.11 Ti II		3.5	3076.07 Eu II	
32	3067.72 Th II		48	3072.34 Co I		9	3076.14 Re I	
13	3068.00 Mo I		4	3072.34 U		3.5	3076.25 Ce II	
5	3068.11 Tm II		4	3072.39 Ce II		5	3076.38 Ta I	
9	3068.26 Ru I		5	3072.41 Nb I		14	3076.66 Bi I	
90	3068.64 Gd II		3.5	3072.45 U		17	3076.69 Ir I	
11	3068.65 U		8	3072.51 Nb II		48	3076.87 Nb II	
5	3068.68 Ce II		55	3072.53 Er II		8	3076.90 Dy II	
3.5	3068.68 Pr		48	3072.56 Gd II		55	3076.92 Gd II	
160	3068.89 Ir I		28	3072.60 Tb II		19	3077.06 Os I	
16 d	3068.90 Th II		24	3072.78 U		13	3077.08 Gd II	
	3068.96 Th II		6	3072.82 Th II		48	3077.24 Ta I	
28	3069.02 Tb II		240	3072.88 Hf I		5	3077.33 Ce II	
19	3069.09 Ir I		8	3072.89 Ce II		5	3077.33 U	
3.5	3069.11 Eu II		20	3072.96 Re I		6	3077.34 Th II	
10	3069.18 Hf I		95	3072.97 Ti II		22	3077.36 Eu II	
12	3069.23 Er II		55	3073.08 Tm II		30	3077.44 Os I	
6	3069.24 Pr		20	3073.13 Mn I		14	3077.52 W II	
70	3069.24 Ta I		12	3073.24 Nb II		500	3077.60 Lu II	
3.0	3069.26 Th II		22	3073.28 W I		4	3077.64 Ce	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
11	3077.66 Mo II		7	3082.01 Tb II		7	3086.85 Y II	
120	3077.72 Os I		11	3082.02 U		14	3087.01 Tm II	
7	3077.83 Cr I		3.5	3082.05 Mn I		8	3087.05 Gd I	
5	3077.93 Th II		70	3082.08 Er II		6	3087.06 V I	
38	3078.11 Os I		11	3082.11 Pr		5	3087.11 U	
7	3078.23 Er II		20	3082.11 V I		6	3087.12 Er II	
19	3078.23 Ta I		320	3082.16 Al I		9	3087.15 Re I	
10	3078.36 Dy II		10	3082.17 Th II		2.5	3087.42 Rh I	
24	3078.38 Os I		8	3082.30 Ce II		19	3087.53 Ta I	
7 c	3078.41 Ho II		44 c	3082.34 Ho II		7	3087.54 Tb II	
190	3078.64 Ti II		50	3082.36 Tb II		34	3087.62 Mo II	
16	3078.69 Dy II		55	3082.43 Re I		8	3087.76 Ta II	
48	3078.82 Th II		10	3082.52 Dy II		7	3087.79 Er II	
10	3078.86 Re I		34	3082.62 Co I		9	3087.86 Nb II	
70	3078.86 Tb II		10	3083.00 Th II		300	3088.02 Ti II	
20	3078.87 Er II		32	3083.22 Ir I		38	3088.04 Ir I	
3.5	3078.99 Pr		10	3083.29 Th II		12	3088.11 V I	
11	3079.34 Dy II		8	3083.35 Gd II		26	3088.43 Tb II	
6	3079.38 Nd II		8	3083.61 U		17	3088.47 Th II	
14	3079.63 Mn I		26	3083.67 Ce II		7	3088.75 Er II	
8	3079.64 Ce II		24	3083.74 Fe I		34	3088.76 Re I	
19	3079.88 Mo I		16	3083.74 Os I		10	3088.99 U	
3.5	3079.88 Th II		8	3083.83 Tb II		5	3089.10 Tb II	
7	3079.91 Ce II		14	3083.96 Rh I		14	3089.10 Yb II	
11	3079.95 U		12	3084.01 Gd II		13	3089.12 Mo I	
14	3079.96 Ta I		60	3084.03 Er II		6	3089.13 V I	
26	3080.11 Lu I		18	3084.21 Re I		17	3089.14 Ru I	
7	3080.11 Tb II		5	3084.24 U II			3089.06 W I	
34	3080.21 Th II		80	3084.36 Ho II		12 c	3089.18 W I	
13	3080.35 Nb II		20	3084.44 Ce II			3089.31 W I	
26	3080.41 Mo I		6	3084.60 Os I		3.5	3089.35 Eu II	
6	3080.64 Ce		6	3084.66 Dy II		15	3089.40 Ti II	
17	3080.66 Hf II		22 d	3084.82 W I		50	3089.58 Tb II	
12	3080.74 U II			3084.91 W I		17	3089.60 Co I	
38	3080.76 Ni I		3.0	3084.90 Pr		13	3089.71 Mo I	
48	3080.84 Hf I			3085.03 Pr		12	3089.80 Ru I	
9	3080.90 Ru I		6	3085.06 Gd II		11	3089.94 Re I	
7	3080.92 Dy II		17	3085.34 Zr I		24	3089.95 Gd II	
6	3080.94 Nd II		22	3085.54 Ta I		24	3090.08 Os I	
34	3081.12 Tm I		100	3085.62 Mo I		9	3090.08 Th II	
5	3081.16 Mo I		5	3085.86 Pr		6	3090.23 Ru I	
7	3081.19 U		7	3085.99 Tb II		15	3090.30 Os I	
8	3081.33 Mn I		6	3086.07 Ru I		8	3090.36 U	
7	3081.38 Er II		6	3086.27 Os I		16	3090.37 Ce II	
340 h	3081.47 Lu I		24	3086.44 Ir I		9	3090.44 Zr I	
10	3081.55 Tb II		7	3086.45 Sm II		12	3090.49 Os I	
3.5	3081.65 Th II		38 c	3086.54 Ho II		6	3090.52 Ce II	
24	3081.85 Ta I		8 d	3086.73 U		4	3090.55 U	
14	3081.98 Th II		42	3086.78 Co I		8	3090.58 W I	
180	3081.99 Gd II		13	3086.78 Tb II		6	3091.25 Os I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
5	3091.25 U		3.5	3095.86 Cr I		300	3100.50 Gd II	
5	3091.29 Ce II		12	3095.88 Er II		26	3100.67 Fe I	
3.5	3091.34 Pr		11	3095.88 Y II		70	3100.67 Re I	
20	3091.58 Fe I		3.5	3096.26 Th II		15	3100.67 Ti I	
10 d	3091.62 Tb II		10	3096.41 Re I		4	3100.71 Yb I	
6 h	3091.70 Y I		7	3096.43 Th II		14 d	3100.79 Th II	
6	3091.87 Ru I		14	3096.50 Ce II			3100.93 Th II	
12	3092.06 Gd II		8	3096.50 Nb I		75	3100.84 Ru I	
4	3092.06 Ta I		34	3096.57 Ru I		14	3100.88 Mo I	
24	3092.07 Mo II		6	3096.68 Sm II		24	3100.94 V II	
10	3092.24 Hf II		22	3096.76 Hf I		10	3101.03 Ta II	
24	3092.44 Ta I		10	3096.86 Tb II		10	3101.18 Gd II	
650 d	3092.71 Al I		5	3096.88 Ce II		4 d	3101.27 Pr	
	3092.84 Al I		8	3096.88 Sm II		70	3101.34 Mo I	
6	3092.73 Nd		5	3096.88 U		6	3101.36 Yb II	
15	3092.92 Nd II		14 hl	3096.90 Mg I		38	3101.40 Hf II	
10	3092.96 Tb II		11	3096.96 Tm II		32	3101.53 Os I	
5	3092.99 Ta I		6	3097.06 Mn I		240	3101.55 Ni I	
24	3093.01 U		3.0	3097.08 Ce		3.5	3101.68 Th II	
6	3093.05 Th II		24	3097.12 Ni I		5	3101.72 Ta I	
9	3093.10 Dy II		15	3097.19 Ti II		5	3101.85 Tm II	
17	3093.11 Tm II		10	3097.27 Th II		120	3101.88 Ni I	
500	3093.11 V II		5	3097.40 Tb II		20	3101.91 Dy II	
15	3093.14 Er II		12	3097.45 Eu II		20	3101.91 Gd II	
7	3093.20 Tb II		12	3097.60 Ru I		4	3102.07 Yb II	
46	3093.51 W I		5	3097.78 Pr		7 h	3102.30 Sm II	
28	3093.59 Os I		13	3098.01 U II		400	3102.30 V II	
20	3093.64 Re I		14	3098.20 Co I		24	3102.39 U	
2.5	3093.76 Y II		9	3098.48 Nd II		24	3102.54 Tb II	
7	3093.80 Dy II		8	3098.50 Pr		50	3102.55 Gd II	
20	3093.87 Ta I		70	3098.60 Tm II		3.5	3102.56 Ce II	
10	3093.87 Yb II		40	3098.64 Gd II		6	3102.61 U	
2.5	3093.99 Cu I		16	3098.90 Gd II		14	3102.66 Th II	
7	3094.01 Ir I		19	3099.12 Ni I		15	3102.69 Er II	
220	3094.18 Nb II		36	3099.19 Er II		20	3102.69 Ho II	
26	3094.20 V II		17	3099.19 Nb II		7	3102.87 Tm II	
70	3094.66 Mo I		44	3099.23 Zr II		3.5	3102.90 U	
7	3094.69 V I		85	3099.28 Ru I		50	3102.97 Tb II	
17	3094.80 Zr I		3.5	3099.52 Nd II		14	3103.06 Re II	
5	3094.83 U		7	3099.60 Er II		2.0	3103.10 Pr	
12	3095.04 U II		7	3099.60 Tm II		16	3103.24 Dy II	
20	3095.06 Re I		7 d	3099.74 Th II		75	3103.25 Ta I	
40	3095.07 Zr II			3099.87 Th II		14	3103.26 Re II	
8	3095.23 U II		55 d	3099.90 Fe I		30	3103.38 Ce II	
24	3095.39 Ta I			3099.97 Fe I		5	3103.77 U	
3.5	3095.59 Ce II		14	3099.93 Mo I		19	3103.80 Ti II	
9	3095.73 Dy II		13	3100.04 Pt I		14	3103.84 Dy II	
13	3095.75 U		50	3100.29 Ir I		7	3104.01 Ce II	
18	3095.79 Re I		26	3100.30 Fe I		19	3104.16 U	
17	3095.82 Zr I		50	3100.45 Ir I		5	3104.42 Ta I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
7	3104.46 Er II		4	3109.76 Pr		3.5	3114.26 Th II	
24	3104.59 La II		7	3109.82 Tb II		2.5	3114.28 Y I	
14	3104.65 Re I		22 c	3109.91 Ho II		7	3114.36 Ho II	
6 d	3104.96 Th		18	3110.02 Th II		7 d	3114.54 U I	
	3105.05 Th II		15	3110.20 Sm II			3114.59 U	
10	3104.98 Os I		26	3110.28 Ce II		9	3114.55 Ir I	
13	3104.99 Dy II		4	3110.52 U		12	3114.81 Os I	
19	3105.08 Ti II		9	3110.55 Ru I		6	3114.91 Rh I	
6	3105.10 U		4	3110.58 Pr		4	3115.05 Sm II	
17	3105.18 Ho II		4	3110.67 Ti II		8	3115.10 Er II	
4	3105.40 Pr		6	3110.68 Mn I		16	3115.18 Nd II	
8	3105.43 Nd II		340	3110.71 V II		12	3115.33 Yb II	
20	3105.47 Ni I		6	3110.75 Dy II		13	3115.52 Er II	
5	3105.65 U		5	3110.82 Ta II		10	3115.86 Ta I	
20	3105.74 Th II		6	3110.83 U		6	3115.93 U	
8	3105.88 W I		3.5	3110.86 Cr I		12	3116.15 Nd II	
38	3105.99 Os I		34	3110.86 Re I		18	3116.28 Th II	
32	3106.18 Eu I		14	3110.87 Hf II		9	3116.36 Nb I	
6	3106.18 Nd II		15	3110.88 Er II		12	3116.48 Os I	
22	3106.23 Ti II		34	3110.88 Zr II		7	3116.48 Th II	
7	3106.34 Mo I		26	3111.09 Os I		6	3116.63 Fe I	
17	3106.52 Sm II		8	3111.12 W I		5	3116.66 Tb II	
110	3106.58 Zr II		24	3111.17 Ce II		8	3116.70 Yb II	
3.5	3106.68 Th II		15	3111.19 Gd I		15	3116.94 Er II	
22	3106.79 Er II		10	3111.34 Pr II		8	3116.95 Hf II	
6	3106.81 Ti I		95	3111.43 Eu I		8	3117.26 Tb II	
14	3107.03 Th II		18	3111.45 Nb I		20	3117.44 Ta I	
10	3107.21 Ta I		14	3111.56 Re I		3.5	3117.50 Dy II	
30	3107.23 W I		40	3111.62 U		7	3117.54 Mo I	
6	3107.38 Os I		5	3111.81 Y I		28	3117.58 W I	
16	3107.47 Ce II		7	3111.85 Ho II		12	3117.67 Ti II	
8	3107.76 Yb II		6	3112.04 Y II		10	3117.68 Th II	
24	3107.90 Yb II		3.5	3112.08 Th II		14	3117.72 Sm II	
4	3108.01 Nd II		170	3112.12 Mo I		26	3117.80 Yb II	
30	3108.02 W I		10	3112.25 U		30	3117.89 Tb II	
36	3108.29 Th II		7	3112.43 Tb II		10	3118.12 Os I	
22	3108.31 Ho II		4	3112.48 Ti I		34 c	3118.19 Re I	
11	3108.36 Gd II		5	3112.53 Tb II		32	3118.33 Os I	
18	3108.37 Zr I		14	3113.17 Gd II		260	3118.38 V II	
10	3108.41 Tb II		5	3113.31 Tm II		200	3118.43 Lu I	
8	3108.46 La II		30 d	3113.54 Er II		85	3118.50 Ho II	
17	3108.65 Ho II		12	3113.57 V II		10	3118.60 Gd II	
70	3108.81 Re I		8	3113.62 Tb II		30	3118.65 Cr II	
8	3108.96 Ce II		13	3113.90 Ta I		15	3118.83 Er II	
32	3108.98 Os I		220	3114.04 Pd I		10	3119.01 Gd I	
80	3109.12 Hf II		3.5	3114.05 Ce II		3.0	3119.03 Pr	
7	3109.15 Tb II		6	3114.05 Ir I		8	3119.05 Er II	
3.5	3109.34 Cr I		3.5	3114.06 Th II		6	3119.24 U	
65	3109.38 Os I		25	3114.12 Ni I		6	3119.25 Cr I	
30	3109.75 Dy II		3.0	3114.14 Pr		22	3119.35 U II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
7	3119.36	Th II	3.5	3123.57	Ce II	42	3128.94	Re I
36	3119.51	Th II	5	3123.69	Gd II	80	3129.18	Zr II
10	3119.59	Ta I	20	3123.70	Rh I	10	3129.20	Pr II
4	3119.60	As I	32	3123.99	Gd II	7	3129.21	Ho II
30	3119.62	Tb II	5	3124.02	Tb II	13	3129.23	Os I
5	3119.71	Cr I	6	3124.17	Ru I	8	3129.55	Ta I
60	3119.72	Ti I	10	3124.25	Gd II	8	3129.58	Hf I
	3119.80	Ti II	26	3124.38	Th II	4	3129.64	Nb II
3.0	3119.75	Nd II	8	3124.43	U	8	3129.73	U
44	3119.94	Gd II	17	3124.54	Tb II	80	3129.76	Zr II
14	3119.98	Hf I	12	3124.58	Nd II	10	3129.93	Y II
14	3120.17	Dy II	20	3124.82	Ge I	15	3129.95	Ta I
9	3120.18	Gd II	7	3124.90	Tm II	8	3129.96	Gd II
32	3120.18	W I	28	3124.90	U II	3.5	3129.98	Th II
55	3120.37	Cr II	60	3124.94	Cr II	70	3130.27	V II
10	3120.73	V II		3125.02	Cr II	18	3130.33	Ce II
55	3120.74	Zr I	50	3124.97	Ta I	480	3130.42	Be II
34	3120.76	Ir I	15	3125.19	Er II	50	3130.58	Ta I
6	3120.87	U	11	3125.19	Zr II	12	3130.73	Eu II
3.5	3120.88	Th I	16	3125.21	Th II	4	3130.73	U
5	3120.92	Ta I	200	3125.28	V II	8	3130.77	Ho II
5	3121.09	U	34	3125.51	Th II	180	3130.79	Nb II
50	3121.14	V II	7	3125.52	Re I	3.0	3130.79	Rh I
6	3121.33	U	11	3125.65	Fe I	20	3130.80	Ti II
34	3121.36	Re I	15	3125.65	Er II	11	3130.81	Gd II
17	3121.42	Co I	40	3125.66	Hg I	22	3130.87	Ce II
10	3121.43	Tb II	7	3125.73	Tm II	34 c	3130.99	Ho II
6	3121.57	Co I	10	3125.74	Th II	8	3131.07	Er II
14	3121.57	Pr II	50	3125.92	Zr II	320	3131.07	Be II
12	3121.76	Rh I	12	3125.96	Ru I	11	3131.07	Th II
20	3121.78	Ir I	14	3126.01	Tm II	22	3131.11	Zr I
15	3121.90	Er II	10	3126.16	Tb II	50	3131.12	Os I
24	3121.94	Tb II	12	3126.17	Dy II	700	3131.26	Tm II
36	3122.00	Mo II	6	3126.17	U	12	3131.35	Tb II
9	3122.38	Ir I	34	3126.22	V II	32	3131.55	Hg I
14	3122.53	Tm I	5	3126.29	Hf II	80	3131.81	Hf I
3.5	3122.60	Cr II	7	3126.70	U II	32	3131.83	Hg I
8	3122.65	Nb I	6	3127.21	Th II	8	3131.99	U
75	3122.67	Er II	8	3127.25	Gd I	13	3132.03	Er II
160	3122.78	Au I	6	3127.38	Er II	75	3132.06	Cr II
8	3122.83	Tb II	18	3127.53	Ce II	55	3132.07	Zr I
20	3122.90	V II	32	3127.53	Nb II	4	3132.16	Eu I
36	3122.96	Th II	20	3127.76	Ta II	28	3132.51	Er II
4	3123.00	Pr	24	3128.39	Dy II	13	3132.59	Ce II
24	3123.05	Tb II	7	3128.39	Ir I	1800	3132.59	Mo I
10	3123.06	Nd II	11	3128.56	Gd II	36	3132.64	Ta I
16	3123.07	Ti I	15	3128.70	Cr II	46	3132.78	Er II
8	3123.09	Er II	10	3128.76	Hf I	9	3132.88	Ru I
7	3123.16	Re I	7	3128.77	Y II	9	3133.08	Nb I
4	3123.29	Tm II	5	3128.88	Tb II	9	3133.09	Gd II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
7	3133.09 Ir I		9	3136.97 Nb I		15	3141.84 Th II	
5	3133.17 Cd I		10	3137.22 Tb II		6	3141.95 U	
17	3133.23 Zr I		6	3137.24 Nd II		10	3142.29 Dy II	
340	3133.32 Ir I		16	3137.30 Gd I		9	3142.31 Ce II	
15	3133.33 Ce II		22	3137.33 Co I		10	3142.44 Nd II	
55	3133.33 V II		8	3137.44 Ta II		26	3142.48 V II	
4	3133.42 U II		14	3137.51 Hf I		14	3142.65 Re I	
55	3133.48 Zr II		9	3137.60 Ce II		18	3142.76 La II	
5	3133.50 Hf II		8	3137.71 Rh I		8	3142.80 Er II	
5	3133.55 Ta I		13	3137.85 Er II		30	3142.81 Pd I	
17	3133.60 Nd II		4	3138.30 Ce II		30	3142.84 Th II	
6	3133.62 Th II		16	3138.49 Er II		8	3142.90 Gd II	
4	3133.63 U		5	3138.51 U		8	3142.96 Ta II	
40	3133.85 Gd II		5	3138.63 Tb II		20	3143.13 Gd II	
10	3133.89 Ta II		110	3138.68 Zr II		7	3143.17 Dy II	
220	3133.89 Tm II		10	3138.71 Gd I		7	3143.30 Sm II	
20	3133.89 W I		14	3138.72 Mo II		9	3143.38 Tb II	
6	3133.92 U		5	3138.83 U		8	3143.63 Er II	
26	3134.02 Re I		30	3139.30 Th II		18	3143.76 Ti II	
260	3134.11 Ni I		32	3139.39 Pt I		16	3143.81 Dy II	
7	3134.18 Sm II		22	3139.56 U II		9	3144.26 Ru I	
26	3134.26 Tb II		46	3139.64 Tb II		24	3144.33 Er II	
22 c	3134.39 Ho II		19	3139.65 Hf II		7	3144.34 Mo I	
11	3134.42 Th II		20	3139.74 V II		34 c	3144.36 Ho II	
95	3134.72 Hf II		4	3139.75 Sc II		16	3144.51 Er II	
13	3134.90 Nd II		7	3139.79 Re I		6	3144.55 Nd II	
28	3134.93 V II		22	3139.80 Zr I		18	3144.60 Ce II	
18	3135.03 Gd II		7	3139.89 Th II		6	3144.82 Nd II	
12	3135.17 Y II		17	3139.94 Co I		22	3144.89 Tm II	
3.0	3135.35 Pr		7	3139.94 Re I		17	3144.96 U	
10	3135.35 Tb II		12	3139.97 Sm II		80	3145.00 Gd II	
60	3135.36 Dy II		20	3140.04 Tb II		11	3145.06 Yb II	
5	3135.60 Mo I		7	3140.27 Th I		7	3145.07 Ir I	
8	3135.62 Er II		10	3140.31 Os I		10	3145.21 Dy II	
7	3135.89 Mo I		7	3140.41 Ir I		24	3145.22 Tb II	
24	3135.89 Ta I, II		9	3140.50 Nb II		26	3145.28 Ce II	
7	3136.22 Th I		26	3140.63 Dy II		25	3145.32 Hf II	
22	3136.30 Sm II		13	3140.76 Hf II		20	3145.34 V II	
12	3136.46 Mo I		32	3140.92 Yb II		46	3145.40 Nb II	
20	3136.51 V II		9	3140.97 Ru I		32	3145.52 Gd II	
9	3136.56 Ru I		36	3141.12 Dy II		4	3145.55 Yb II	
18	3136.68 Cr II		40	3141.13 Er II		20	3145.56 U II	
15	3136.72 Ce II		25	3141.38 Re I		3.5	3145.63 Th I	
6	3136.75 Mo I		16	3141.42 W I		5	3145.72 Ni I	
7	3136.75 Yb II		10	3141.46 Nd II		7	3145.97 V II	
5	3136.79 Pr II		12	3141.54 Ti I		22	3146.04 Th II	
3.5	3136.83 Th I		8	3141.67 Ti I		8	3146.13 Ho II	
6	3136.89 U		11	3141.72 Yb II		18	3146.15 Dy II	
16	3136.93 Gd I		7	3141.81 Er II		22	3146.16 Tm II	
28	3136.96 Zr I		4	3141.84 Sn I		4	3146.23 Ce II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
6	3146.23 V II		7	3151.54 Pr II		7	3155.64 Mo II	
8	3146.26 U		13	3151.63 Hf I		20	3155.67 Ti II	
26	3146.41 Ce II		44	3151.64 Re I		46	3155.67 Zr II	
6	3146.47 Pr		7	3151.64 Th II		30 d	3155.69 Ce II	
16	3146.67 Tb II		17	3151.87 Nb I			3155.79 Ce II	
6	3146.75 U		11	3151.88 Dy II		11	3155.78 Rh I	
20	3146.88 Gd II		10	3152.07 Os I		7	3155.83 Th II	
32	3147.04 Tb II		15	3152.10 Sm II		11	3155.86 U	
26	3147.06 Co I		8	3152.16 Nb II		8	3156.07 U	
11	3147.09 U		9	3152.20 Dy II		22	3156.18 Ho II	
32	3147.13 Tb II		20	3152.25 Ti II		320	3156.25 Os I	
12	3147.19 Sm II		6	3152.31 U		7	3156.39 Th II	
18	3147.23 Cr II		11	3152.35 Dy II		110	3156.51 Dy II	
28	3147.35 Mo I		14	3152.37 Er II		7	3156.51 Mo I	
10 c	3147.37 Ta I		34	3152.52 Sm II		5	3156.52 Tb II	
9	3147.50 Dy II		4	3152.60 Rh I		100	3156.53 Gd II	
18	3148.04 Ta I		26	3152.67 Os I		14	3156.56 Pt I	
20	3148.04 Ti II		6	3152.71 Co I		50	3156.63 Hf I	
9 h	3148.18 Mn I		28	3152.82 Mo II		5	3156.76 Ta II	
7	3148.21 Tb II		4	3152.96 Hf I		26	3156.78 Os I	
25	3148.41 Hf I		8	3152.96 W I		30	3156.97 Ho II	
11	3148.44 Cr I		7 c	3153.04 Ho II		24	3157.00 Zr II	
9	3148.46 Ce II		22	3153.12 U		14	3157.24 Os I	
6	3148.51 Nd II		4	3153.17 Yb II		13	3157.35 Ho I	
6	3148.56 U		7	3153.20 Pr		140	3157.35 Tm II	
6	3148.65 Ce II		9	3153.30 Dy II		6	3157.45 U	
32	3148.71 Tb II		30	3153.61 Os I		5	3157.49 Tb II	
28	3148.82 Zr I		33	3153.79 Re I		6	3157.53 Dy II	
17 c	3148.85 Ho II		14	3153.82 Ho I		50	3157.82 Zr I	
7	3149.15 Tm II		12	3153.82 Ru I		8	3157.86 U	
28	3149.21 U		6	3153.83 Pr		10	3157.96 Ta II	
6	3149.29 Nd II		13	3153.86 Yb II		750	3158.16 Mo I	
4	3149.43 Ce II		20	3154.20 Ti II		36 c	3158.31 Re I	
6	3149.51 Nd II		40	3154.28 Er II		13	3158.40 Ho II	
8	3149.85 W II		22	3154.30 Th II		3.5	3158.62 Th II	
5	3149.88 Eu II		12	3154.51 Ce II		20	3158.63 Gd I	
13	3149.94 Ho II		7	3154.55 Ir I		10	3158.65 Pr II	
7	3150.07 Tm II		26 d	3154.68 Co I		8	3158.66 Tb II	
4	3150.36 U			3154.79 Co I		22	3158.78 Co I	
11	3150.46 Th II		7	3154.69 Tb II		20	3158.87 Ca II	
13	3150.53 Er II		19	3154.74 Ir I		6	3158.89 Ru I	
19	3150.61 Ir I		22	3154.77 Th II		5	3159.05 Ta I	
6	3150.69 Ru I		7	3155.10 Tb II		3.5	3159.07 Th II	
5	3150.85 Ta I		8	3155.10 W I		19	3159.15 Ir I	
180	3151.04 Tm II		13	3155.15 Cr I		12	3159.18 W I	
6 h	3151.08 U II		7	3155.17 Yb II		10	3159.22 Tb II	
7	3151.13 Ce II		5	3155.25 Ta II		10	3159.39 Tb II	
7	3151.16 Re I		4	3155.26 U		22 c	3159.67 Ho II	
5	3151.32 V II		6	3155.41 U II		30	3159.82 Hf I	
4	3151.36 Rh I		13	3155.62 Tb II		6	3159.82 U	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
30	3159.92 Ru I		9	3164.82 Pr II		26	3169.18 Ce II	
19	3160.34 Er II		5	3164.83 V II		8	3169.32 Th II	
7	3160.47 Ho II		7	3164.87 Tm II		3.0	3169.37 Pr	
11	3160.50 Dy II		7	3165.20 Yb II		8	3169.47 Gd II	
14	3160.69 Gd II		4	3165.28 U		24	3169.84 Tb II	
8	3160.77 U		16	3165.38 W I		30	3169.88 Sm II	
10	3161.02 Dy II		24	3165.45 Zr II		90	3169.97 Dy II	
14 h	3161.04 Mn I		9	3165.50 U		12	3170.20 W I	
42	3161.20 Ti II		4	3165.62 Th II		7	3170.21 Sm II	
6	3161.35 Er II		13	3165.69 Ho II		42	3170.29 Ta I	
100	3161.37 Gd II		10	3165.73 Hf I		1100	3170.35 Mo I	
13	3161.44 Os I		20	3165.74 Tb II		4	3170.42 Th II	
5	3161.68 Th II		8	3165.82 Th II		16	3170.73 Dy II	
12	3161.73 Os I		140	3165.97 Zr II		6	3170.86 U	
65	3161.77 Ti II		10	3166.09 Th II		7	3170.92 Dy II	
7	3162.15 Sm II		13	3166.24 Ce II		9	3171.09 Gd II	
12	3162.30 Sm II		24	3166.26 Zr II		10	3171.19 Tb II	
4	3162.31 Yb I		32	3166.51 Os I		2.5	3171.23 Pr	
14	3162.42 Tb II		9	3166.61 Ce II		4	3171.26 Th I	
7	3162.44 Tm II		65 c	3166.62 Ho II		140	3171.36 Lu I	
85	3162.57 Ti II		19	3167.09 Er II		6	3171.37 U II	
80	3162.61 Hf II		9	3167.10 U		6	3171.38 Dy II	
6	3162.62 Nd II		5	3167.16 Re I		7	3171.38 Mo I	
10	3162.72 Ta I		8	3167.20 Gd I		8	3171.52 Er II	
60	3162.81 Dy II		4	3167.23 Ce II		26	3171.61 Ce II	
8	3162.83 Th II		4	3167.32 Ce II		20	3171.68 La III	
30	3162.93 Tb II		11	3167.42 Dy II		3.0	3171.68 Th II	
19	3163.13 Ta I		40	3167.52 Tb II		44 dl	3171.72 Ho II	
5	3163.39 Hf I		10	3167.53 Ta I		12	3172.03 Mo II	
140	3163.40 Nb II		6	3167.55 Th II		4	3172.30 Ce II	
36	3163.42 W I		8	3167.58 W I		19	3172.31 Pr II	
4	3163.73 U		7 h	3167.77 Dy II		9	3172.37 Ho II	
16	3163.74 Pr II		18	3167.89 Ho II		5	3172.37 Mo I	
13	3163.76 Cr I		7	3168.10 Dy II		5	3172.51 Nb I	
10	3163.79 Yb II		7	3168.14 V II		8	3172.62 Er II	
9	3163.82 Ta I		14	3168.18 Ir I		42	3172.66 Tm I	
10	3163.85 Tb II		9	3168.18 Ta II		20	3172.74 Mo II	
12	3163.90 Mo I		18	3168.19 Tm II		220	3172.83 Tm II	
9 d	3164.05 Dy II		32	3168.24 Pr II		10	3172.87 Ta I	
7	3164.06 Ho II		13	3168.28 Os I		100	3172.94 Hf I	
8	3164.10 Tb II		15	3168.32 Tb II		14	3173.06 Y II	
26	3164.15 Ce II		70	3168.37 Re I		14	3173.09 Re I	
85	3164.31 Zr II		50	3168.39 Hf I		9	3173.20 Nb II	
16	3164.44 W I		20	3168.52 Ru I		13	3173.20 Os I	
8	3164.48 Th II		130	3168.52 Ti II		4	3173.43 Th I	
6	3164.52 Er II		5	3168.59 Tb II		36	3173.58 Tm II	
22	3164.52 Re I		7	3168.82 Tm II		36	3173.59 Ta I	
15	3164.53 Mo I		48	3168.88 Ir I		9	3173.61 Eu II	
9	3164.61 Os I		9	3168.92 Dy I		4	3173.71 U	
10	3164.77 Tb II		17	3169.06 Yb II		20	3173.76 Tb II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
90	3173.78 Ho II		50	3179.33 Ca II		46	3183.03 Mo I	
19	3173.93 Os II		28	3179.41 Y II		4	3183.13 Th II	
8	3174.19 Th II		4	3179.61 Hf I		6	3183.19 Dy II	
22	3174.61 Re I		8	3179.62 Er II		10	3183.29 Tb II	
40	3174.66 Tb II		6	3179.73 Rh I		420	3183.41 V I	
14	3174.78 Re I		12	3179.77 Mo I		40	3183.42 Er II	
44	3174.84 Ho II		9	3179.83 U		44	3183.52 Ce II	
12	3174.88 Dy II		5	3179.84 Tb II		10	3183.64 Tb II	
550	3175.05 Sn I		11	3180.12 Os I		6	3183.73 Lu II	
10	3175.11 Te I		75	3180.20 Th II		4	3183.79 Th II	
6	3175.36 U		9	3180.20 U		44	3183.84 Ho II	
7	3175.45 Fe I		14	3180.23 Fe I		15	3183.88 Tb II	
8	3175.45 Tb II		46	3180.29 Nb II		60	3183.92 Sm II	
16	3175.52 Er II		17	3180.35 Ir I		700	3183.98 V I	
30	3175.72 Th II		40	3180.54 Tb II		16	3184.04 W I	
18	3175.78 Nb II		14	3180.56 Tm I		7 d	3184.19 Dy II	
	3175.86 Nb II		30	3180.70 Cr II		7	3184.21 Ce II	
6	3175.99 Nd II		8	3180.74 W I		9	3184.22 Nb II	
14	3176.21 U		4	3180.82 Ce II		9	3184.37 Ni I	
26	3176.29 Ta I		17	3180.92 Yb II		16	3184.42 W I	
4	3176.50 Th II		80	3180.95 Ta I		30 cw	3184.48 Ho II	
40	3176.59 W I		25	3181.01 Hf I		32	3184.55 Ta I	
12	3176.80 Ce II		13	3181.15 Hf I		15	3184.57 Mo I	
50	3176.86 Hf II		8	3181.18 Th II		110	3184.76 Re I	
30 c	3176.97 Ho II		5	3181.22 Tb II		18	3184.77 Dy II	
6	3177.05 Ru II		9	3181.28 Ca II		6	3184.90 Fe I	
4	3177.14 Ce II		8	3181.40 Nb II		22	3184.94 Th II	
4	3177.17 Th II		4	3181.43 Cr II		46	3185.10 Mo I	
8	3177.27 Co I		90 c	3181.50 Ho II		5	3185.14 U	
14	3177.33 U		3.0	3181.54 Nd II		24	3185.26 Er II	
12	3177.46 Tm II		30	3181.58 Zr II		24	3185.33 Os I	
36	3177.58 Ir I		4	3181.66 Th II		500	3185.40 V I	
44	3177.71 Re I		32 d	3181.68 Er II		14	3185.47 Tm II	
36	3177.87 Dy II		14	3181.69 Ta I		4	3185.54 Eu I	
12	3177.90 Mo I		5	3181.74 Ni I		110	3185.57 Re I	
44	3178.06 Os I		24	3181.81 W I		7	3185.59 Rh I	
30	3178.09 Zr II		24	3181.88 Os I		22	3185.71 Mo I	
15	3178.12 Sm II		7	3181.92 Dy II		11	3185.71 U	
19	3178.16 Ta I		85	3181.92 Er II		7	3186.02 Sm II	
	3178.27 Ta I		24	3181.92 Zr II		18	3186.04 Ru I	
7	3178.20 Tm II		6	3182.40 Th II		22	3186.13 Ce II	
6	3178.24 Th I		10	3182.45 Pr II		10	3186.23 Tb II	
20	3178.35 Dy II		3.0	3182.55 U		12	3186.29 Re I	
5	3178.43 Hf I		18	3182.57 Os I		30	3186.37 Dy II	
22 h	3178.50 Mn I		15	3182.57 Ta I		22	3186.37 Ho I	
26	3178.61 Re I		8	3182.64 Th II		200	3186.45 Ti I	
4	3178.75 Ce II		7	3182.66 Re I		9	3186.54 Nb I	
9	3179.04 U		3.0	3182.83 U		32	3186.98 Os I	
19	3179.05 Th II		140	3182.86 Zr II		4	3187.00 Th II	
16	3179.06 W I		60	3182.87 Re I		26	3187.01 Sm II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
36	3187.22	Sm II	36	3191.10	Nb II	40	3195.60	Tb II
50	3187.25	Tb II	16	3191.16	Ta I	7	3195.61	Hf II
6	3187.34	Os I	40	3191.19	Rh I	300	3195.62	Y II
16	3187.39	Ho II	6	3191.21	Th II	4	3195.69	Th I
4	3187.40	Th II	85	3191.21	Zr I	4	3195.94	Ce II
24	3187.49	Nb I	9	3191.31	Y I	36	3195.96	Mo I
15 d	3187.59	Mo II	13	3191.41	Pr II	13	3195.97	Os I
	3187.68	Mo I	18	3191.43	Nb II	24 d	3196.04	Pr II
22	3187.67	Dy II	12	3191.52	Mo I	16 c	3196.07	Ho II
55	3187.71	V II	48	3191.57	W I	30	3196.18	Sm II
16	3187.79	Er II	7	3191.66	Fe I	7	3196.52	Ho II
30	3187.79	Sm II	8	3191.69	Pr	12	3196.54	Tm II
8 h	3188.01	Cr I	3.0	3191.76	U	18	3196.59	Ru I
30	3188.03	Tb II	15	3191.80	Lu II	5	3196.74	U
8	3188.09	Mo I	34	3191.90	Zr II	24	3196.93	Fe I
55	3188.23	Th II	260	3191.99	Ti I	22	3196.93	Hf I
24	3188.34	Ru I	10	3192.25	Ta I	12	3197.04	Zr I
9	3188.34	U II	26	3192.36	Re I	28	3197.08	Cr II
8	3188.37	Co I	4	3192.57	Th I	14	3197.11	Ni I
8	3188.40	Mo I	12	3192.63	Er II	16	3197.13	Rh I
70	3188.51	V II	7	3192.76	Tb II	4	3197.52	Ti II
10	3188.55	Tb II	7	3192.80	Fe I	44 c	3197.83	Ho II
6	3188.66	Dy II	12	3192.80	Mo I	70	3198.01	V I
7	3188.72	Sm II	55	3192.88	Yb II	5	3198.02	Tb II
3.0	3188.73	Nd II	6	3192.98	Dy II	3.0	3198.11	Cr I
16	3188.79	Ce II	30	3193.01	Sm II	80	3198.12	Lu II
5	3188.83	Tb II	10	3193.02	La II	8	3198.23	Th II
6	3189.02	U	4	3193.16	Th II	8	3198.48	Th II
12	3189.05	Rh I	9	3193.17	Gd II	22	3198.58	Re I
8	3189.24	W II	14	3193.20	Re I	10	3198.65	Yb II
9	3189.28	Nb II	11	3193.23	Fe I	26	3198.67	Ta I
3.0	3189.42	U	9	3193.23	U	8	3198.71	Th II
32	3189.46	Os I	30	3193.31	Dy II	48	3198.84	W I
15	3189.62	Hf I	4	3193.33	Ce	15	3198.85	Mo I
9	3189.64	Ce II	40	3193.53	Hf II	36	3198.92	Ir I
10	3189.97	Tb II	7	3193.92	V I	6	3198.96	Th II
24	3189.98	Ru I	950	3193.97	Mo I	13	3199.05	Pr II
19 d	3190.07	Th II	8	3194.10	Cu I	18	3199.28	Ce II
	3190.17	Th II	5	3194.18	Tb II	22	3199.30	Gd I
15	3190.17	Re I	75	3194.19	Hf II	7	3199.49	Re I
22	3190.28	Gd I	32	3194.23	Os I	14	3199.52	Fe I
18	3190.34	Ce II	20	3194.50	Re I	50	3199.56	Tb II
100	3190.68	V II	20	3194.71	Tb II	16	3199.58	Gd I
6	3190.70	U	65	3194.83	Ce II	7	3199.82	V I
5	3190.72	Tb II	8	3194.87	Mo I	320	3199.92	Ti I
26	3190.78	Re I	120	3194.98	Nb II	15	3199.99	Hf II
85	3190.87	Ti II	8	3195.09	Ho II	12	3200.00	Tm II
3.0	3190.89	U	22	3195.33	Tm II	15	3200.04	Re I
18	3191.02	Ho II	20	3195.38	Os I	10	3200.14	U
8	3191.08	Th II	5	3195.57	Ni I	8	3200.21	Mo I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
280	3200.27 Y II		60	3205.58 V I		14	3211.75 Re I	
15	3200.48 Fe I		110	3205.88 Mo I		3.0	3211.77 U	
4 d	3200.52 Ce II		9	3205.96 Ce II		13	3211.85 Ho II	
8	3200.53 Nb I		14	3206.05 U		15	3211.99 Fe I	
30	3200.57 Er II		35	3206.11 Hf I		85	3212.01 Zr I	
3.0	3200.62 Nd II		11	3206.17 Ho I		30	3212.02 Tm II	
12	3200.71 Pt I		6	3206.23 U II		12	3212.03 Dy II	
10	3200.72 Re I		36	3206.34 Nb II		60	3212.12 Ir I	
16	3200.73 Tb II		22	3206.39 Dy II		7	3212.43 Dy II	
8	3200.89 Mo I		20	3206.39 Ta I		55	3212.43 V I	
12	3201.00 Ho I		7	3206.47 Gd II		7	3212.58 Zr I	
34	3201.16 Yb II		7	3206.62 Dy II		15	3212.59 Mo I	
5	3201.50 Mo II		22	3206.86 Ho II		7	3212.67 Dy II	
90	3201.71 Ce II		4	3206.94 Th II		110	3212.81 Eu I	
44	3201.76 Ho II		8	3207.09 Tb II		12	3212.85 Zr II	
12	3201.80 Sm II		20	3207.10 Dy II		34	3212.88 Mn I	
5	3201.98 Ta I		30	3207.18 Sm II		12	3212.94 Re I	
5	3202.14 Ni I		65	3207.25 W I		6	3212.97 Ru I	
100	3202.38 V I		60	3207.41 V I		3.0	3213.09 U II	
65	3202.54 Ti II		14	3207.53 Tb II		9	3213.14 Ti II	
10	3202.70 Tb II		4	3207.78 Th II		9	3213.28 Ho II	
7	3202.95 Tb II		6	3207.85 Ta I		16	3213.31 Os II	
4	3203.23 Th II		12	3207.89 Pr		8	3213.32 Mo I	
280	3203.32 Y II		10	3207.96 Tb II		7	3213.49 Re	
14	3203.35 Nb II		4	3208.03 Th II		7	3213.55 Ir I	
11	3203.41 Gd I		8	3208.05 Er II		12	3213.57 Th II	
12	3203.42 Er II		15	3208.17 Sm II		6	3213.58 Pr	
4	3203.44 Ti II		2.5	3208.23 Cu I		10	3213.72 Hf I	
9	3203.47 Nd II		17	3208.28 W I		44	3213.75 Eu I	
3.0	3203.61 Th II		10	3208.35 V II		26	3213.91 Ta II	
5	3203.67 Hf II		4	3208.59 Cr II		30	3214.04 Fe I	
20	3203.83 Ti I		26	3208.81 Dy II		16	3214.06 Ni I	
4	3203.88 Th II		380	3208.83 Mo I		4	3214.08 Th I	
8	3203.95 Er II		22	3209.18 Cr II		12	3214.11 Re I	
32	3204.04 Pt I		7	3209.54 Tb II		12	3214.12 Sm II	
110 c	3204.25 Re I		5	3210.01 Tb II		120	3214.19 Zr II	
18	3204.28 Ho II		16	3210.22 Tb II		22	3214.24 Ti I	
4	3204.35 Zr II		9	3210.29 Nb I		6	3214.32 Rh I	
3.5	3204.81 Pr		12	3210.31 Th II		4	3214.38 Th I	
4	3204.87 Ti I		30 c	3210.41 Ho II		6	3214.40 Fe I	
12	3204.90 Sm II		44	3210.57 Eu I		4	3214.40 Pr	
15	3204.90 Zr I		30	3210.57 Tm II		15	3214.44 Mo I	
10	3205.00 Ta		7	3210.83 Fe I		26	3214.45 Er II	
22	3205.15 Er II		30	3210.83 Tm II		17	3214.63 Dy II	
42	3205.22 Mo I		9	3210.95 Ce II		12	3214.63 Tm II	
4	3205.28 Th II		30	3210.97 Mo I		3.0	3214.70 U	
11	3205.40 Fe I		20	3210.98 Hf I		16	3214.75 Ti II	
7	3205.42 Re I		5	3211.00 Nd II		10	3214.75 V II	
12	3205.46 Dy II		4	3211.20 Th I		10	3215.01 Tb II	
15	3205.54 Mo I		50	3211.73 Sm II		70	3215.07 Mo I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
42	3215.19	Dy II	14	3220.45	Dy II	30	3225.98	Dy II
5	3215.26	Gd I	3.0	3220.57	Pb I	7	3226.05	Dy II
22	3215.26	Sm II	20	3220.61	Hf II	4	3226.12	Th II
16	3215.36	Ho II	85	3220.73	Er II	12	3226.13	Ti I
130	3215.56	W I	500	3220.78	Ir I	10	3226.17	U
46	3215.60	Nb II	8	3220.86	Mo I	16	3226.32	Gd II
4	3215.78	Th II	9	3220.87	Ce	11	3226.37	Ru I
5	3215.81	La I	80	3221.17	Ce II	13	3226.38	Dy II
7	3215.94	Fe I	17	3221.21	W I	4	3226.41	Th II
7	3216.12	Tm II	9	3221.27	Ni I	7	3226.81	Tm II
6	3216.52	Ru I	10	3221.28	Ir I	22	3226.86	Sm II
75	3216.62	Dy II	40	3221.28	Th II	65	3227.11	Ce II
500	3216.69	Y II	10	3221.32	Ta I	20	3227.16	Er II
44	3216.85	Sm II	9	3221.38	Ti I	24	3227.32	Ta I
20	3216.93	Ta I	22 c	3221.42	Ho II	15	3227.46	Re I
10	3216.95	Mn I	22	3221.50	Dy II	5	3227.48	Tb II
90	3217.06	Ti II	15	3221.62	Dy II	19	3227.75	Fe II
28	3217.11	V I, II	14	3221.65	Ni I		3227.80	Fe I
6	3217.12	Nd II	44	3221.74	Mo I	8	3227.78	Th II
11	3217.18	Yb II	17	3221.91	W I	10	3227.88	Ru I
11	3217.29	Nb I	34	3222.07	Fe I	3.0	3228.04	Nd II
20	3217.30	Hf II	5	3222.37	Tb II	160	3228.09	Mn I
7	3217.36	Dy II	4	3222.41	Ce II	110	3228.22	Mo I
5	3217.38	Fe I	17	3222.47	Zr II	15	3228.50	Sm II
18	3217.40	Cr II	3.0	3222.62	Nd I	22	3228.53	Ru I
12	3217.45	Th II	110	3222.84	Ti II	44	3228.60	Ti II
4	3217.73	Th II	10	3222.97	Tb II	7	3228.73	Re I
16	3217.83	Ni I	18	3223.27	Ru I	22	3228.78	Sm II
8	3217.86	Nb I	26	3223.29	Dy II	32	3228.81	Zr II
9	3217.94	Ti I	60	3223.31	Er II	7	3228.90	Tm II
22	3218.27	Ti II	9	3223.32	Nb II	15	3228.97	Dy II
7	3218.33	Yb II	4	3223.37	Ce II	40	3229.01	Th II
9	3218.34	U	8	3223.49	Mo I	9	3229.12	Ce II
18	3218.38	Ce II	18	3223.52	Ti I	16	3229.19	Tb II
7	3218.46	Ir I	70	3223.74	Gd II	65	3229.19	Ti II
50	3218.61	Sm II		3223.78	Gd I	4	3229.20	Cr I
5	3218.87	V I	40	3223.83	Ta I	30	3229.24	Ta I
120	3218.93	Tb II	20	3224.24	Ti II	30	3229.28	Ir I
65	3218.94	Ce II	10	3224.26	U	22	3229.36	Ce II
6	3219.15	Co I	9	3224.27	Ho II	15	3229.36	Dy II
6	3219.17	U	19	3225.02	Ni I	44	3229.42	Ti II
9	3219.21	Ti I	22	3225.08	Dy II	30	3229.50	U
12	3219.43	Sm II	20	3225.42	Th II	17	3229.56	Nb II
36	3219.51	Ir I	11	3225.46	Gd II	120	3229.75	Tl I
22	3219.55	Pr II	95	3225.48	Nb II	75	3229.79	Mo I
12	3219.58	Fe I	4	3225.66	Th II	11	3229.88	Ta II
7	3219.81	Fe I	30	3225.67	Ce II	8	3229.93	Er II
130	3219.95	Tb II	50	3225.79	Fe I	10	3229.95	Dy II
10	3220.17	Tb II	7	3225.86	Yb II	26	3230.03	Tb II
12	3220.35	Th II	4	3225.90	Th II	7	3230.04	Ho II

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
15	3230.06 Hf I		12	3234.22 Pr II		6	3239.20 Yb II	
4	3230.08 Ce II		10	3234.50 Tb II		7	3239.29 Th II	
4	3230.22 Pr		550	3234.52 Ti II		30	3239.44 Fe I	
3.0	3230.29 Pt I		3.5	3234.62 Nd		15	3239.44 Hf I	
60	3230.56 Sm II		26	3234.65 Ni I		5	3239.60 Yb I	
220	3230.59 Er II		11	3234.69 Ta I		60	3239.66 Sm II	
46	3230.72 Mn I		30	3234.89 Ce II		22 d	3239.66 Tb II	
10	3230.76 Ir I		4	3235.00 Th I		18	3239.66 Ti II	
16	3230.86 Ta I		4	3235.01 Ce		9	3239.99 Ta I	
8	3230.86 Th II		5	3235.13 Eu I		26	3240.00 Tb II	
7	3230.97 Fe I		3.0	3235.23 U		150	3240.23 Tm II	
26	3231.06 Tb II		24	3235.38 Mo I		3.0	3240.35 U	
44	3231.24 Ce II		3.0	3235.43 Pr		7	3240.42 Ho II	
9	3231.32 Ti II		44	3235.45 Tm II		14	3240.48 Er II	
10	3231.46 Tb II		7	3235.67 Ce II		8	3240.48 Th II	
22	3231.51 Tm II		12	3235.79 Tb II		24	3240.49 Mo I	
30	3231.53 Sm II		34	3235.85 Th II		4	3240.64 Th II	
9 c	3231.67 Ho II		44	3235.89 Dy II		20	3240.65 Tb II	
100	3231.69 Zr II		38	3235.94 Re I		8	3240.71 Mo II	
12	3231.95 Sm II		18	3236.12 Ti II		13	3240.88 Dy II	
6	3232.00 Ir I		10	3236.20 Tb II		16	3240.94 Ta II	
9	3232.00 Tb II		48	3236.40 Nb II		20	3241.04 Os I	
24	3232.03 Er II		5	3236.40 Ta I		120	3241.05 Zr II	
200	3232.06 Os I		440	3236.57 Ti II		17	3241.12 Th II	
8	3232.13 Th II		17	3236.58 Zr II		44	3241.16 Sm II	
28	3232.16 U II		26	3236.64 Dy II		12	3241.24 Ru I	
20	3232.28 Ti II		60	3236.64 Sm II		10	3241.40 Eu I	
3.0	3232.31 Th I		36	3236.74 Ce II		8	3241.47 Re I	
24	3232.49 W I		130	3236.78 Mn I		46	3241.52 Ir I	
100	3232.52 Sb I		110	3236.81 Tm II		220	3241.53 Tm II	
17	3232.61 Li I		22	3236.90 Ho II		15	3241.59 Sm II	
13	3232.64 Dy II		120	3237.08 Mo I		220	3241.99 Ti II	
10	3232.65 W I		17	3237.09 W I		9	3241.99 U II	
5	3232.73 Tb II		22	3237.40 Ho II		17	3242.02 W I	
22	3232.78 Gd I		15	3237.51 Re I		15	3242.04 Sm II	
8	3232.87 Co I		7	3237.66 Rh I		26	3242.05 Ta I	
100	3232.96 Ni I		8	3237.73 Cr I		800	3242.28 Y II	
140	3233.14 Mo I		20	3237.87 V II		1200	3242.70 Pd I	
7	3233.19 V I		12	3237.89 Sm II		26	3242.83 Ta I	
36	3233.34 Ho II		2.5	3237.91 Nd II		9	3243.00 Ho II	
6	3233.34 U		32	3237.98 Er II		55	3243.06 Ni I	
2.0	3233.42 Pt I		14	3237.98 Mo I		8	3243.20 Tb II	
13	3233.44 Ce II		42	3238.12 Th II		18	3243.25 Er II	
36	3233.68 Sm II		3.0	3238.42 U		15	3243.35 Hf I	
7	3233.75 Tm I		22	3238.53 Ru I		36	3243.37 Ce II	
9	3233.87 Ho II		9	3238.62 Gd II		9	3243.48 Er II	
7	3233.97 Fe I		30	3238.63 Os I		12	3243.50 Ru I	
3.5	3234.06 Cr II		5	3238.87 Pr II		9 h	3243.78 Dy II	
100	3234.12 Zr I		4	3238.94 Th I		50	3243.78 Mn I	
65	3234.16 Ce II		340	3239.04 Ti II		14	3243.84 Co I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
18	3244.17	U	19	3249.52	Nb I	38	3254.07	Nb II
22	3244.19	Fe I	25	3249.53	Hf I	6	3254.08	Nd II
8	3244.46	Th I	7	3249.57	V I	24	3254.21	Co I
6	3244.47	Mo I	7	3249.61	Tb II	100	3254.25	Ti II
5	3244.60	Tb II	20	3249.75	Sm II	32	3254.28	Zr I
12	3244.69	Sm II	7	3249.83	Tm II	280	3254.31	Lu II
6	3244.79	U II	7	3249.87	Th I	26	3254.36	W I
70	3245.13	La II	8	3249.92	Mo I	70	3254.38	Sm II
44	3245.16	Dy II	10	3250.19	Gd II	8	3254.40	Ir I
9	3245.17	Ce II	6	3250.28	U	7	3254.47	Dy II
10	3245.17	Tb II	2.0	3250.36	Pt I	8	3254.54	Ru I
5	3245.42	Tb II	5	3250.36	Ta I	6	3254.71	Ru I
12	3245.46	Pr II	60	3250.37	Sm II	18	3254.77	V II
15	3245.54	Cr I	50	3250.39	Zr I	10	3254.82	Th II
20	3245.78	Th II		3250.46	Zr II	9	3254.84	U
7	3245.80	Sm I	11	3250.74	Ni I	8	3254.86	Hf I
12	3245.86	Tm II	5	3250.75	Tb II	20	3254.91	Os I
8	3245.92	Mo I	7	3250.78	V II	7	3255.22	Tb II
5	3246.03	Eu I	5	3250.95	Tb II	30	3255.28	Hf II
5	3246.06	Yb II	8	3250.99	Dy II	10	3255.51	Th II
9	3246.11	U	16	3251.14	Mn I	9	3255.63	Sm II
9	3246.39	U II	16	3251.25	Tb II	5	3255.65	V I
18	3246.67	Ce II	110	3251.28	Dy II	140	3255.69	Sc I
5	3246.78	Nb I	90	3251.32	Sc II	16	3255.92	Pt I
16	3247.18	Co I	7	3251.33	Tm II	1300 c	3256.09	In I
5	3247.18	Tb II	9	3251.62	Nb I	48	3256.14	Mn I
9	3247.22	Ho II	15	3251.63	Tm II	120	3256.21	Mo I
5	3247.32	Eu II	300	3251.64	Pd I	26	3256.26	Dy II
40	3247.46	Tm II	16	3251.84	Cr I	9	3256.28	Ho II
24	3247.47	Nb II	5	3251.87	V II	65	3256.28	Th II
3.0	3247.49	U	15	3251.90	Dy II	9	3256.34	Er II
5000	3247.54	Cu I	80	3251.91	Ti II	3.0	3256.91	Nd II
11	3247.55	Eu I	20	3251.92	Th I	20	3256.92	Os I
8	3247.59	Th II	4	3251.98	Pt I	13	3257.16	Th II
40	3247.66	Hf I	18	3252.20	Dy II	3.0	3257.26	U
13	3248.00	Os I	15	3252.26	Re I	7	3257.35	Dy II
4	3248.07	U	17	3252.29	W I	13	3257.38	Th I
18	3248.37	Dy II	50	3252.34	Tb II	22 c	3257.45	Ho II
9	3248.46	Ni I	13	3252.48	Ce II	16	3257.82	Cr I
100	3248.52	Mn I	10	3252.74	Th II	180	3258.05	Tm II
5	3248.52	Ta I	100	3252.91	Ti II	7	3258.25	Sm II
8	3248.53	Th II	48	3252.95	Mn I	34	3258.41	Mn I
8	3248.55	Re I	30	3253.40	Sm II	13 c	3258.45	Ho II
100	3248.60	Ti II	7	3253.54	Tb II	9	3258.48	Er II
14	3248.94	Nb II	100	3253.70	Hf II	300	3258.56	In I
4	3249.14	U	6	3253.80	U	380	3258.78	Pd I
9	3249.19	Ce II	7	3253.91	Dy II	60	3258.85	Re I
32	3249.34	Er II	22	3253.94	Sm II	9	3258.87	Ce II
36	3249.35	La II	13	3254.01	Ce II	55	3259.06	Er II
4	3249.43	Ce II	10	3254.04	Mn I	8	3259.06	Th I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
14	3259.16	Mo I	5	3263.12	U I	10	3267.25	Nd II
13	3259.24	Nd II	44	3263.14	Rh I	10	3267.36	Ho II
11	3259.25	Gd II	18	3263.24	V I	110	3267.40	Tm II
10	3259.38	Tb II	19	3263.37	Nb II	85	3267.51	Sb I
17	3259.44	W I	13	3263.45	Ce II	26	3267.64	Gd I
60	3259.55	Re I	5	3263.65	Tb II	140	3267.70	V II
8	3259.61	Th II	8	3263.66	Ho II	320	3267.94	Os I
26	3259.66	W I	14	3263.83	Mo I	20	3268.10	Tb II
12	3259.98	Cr I	18	3263.88	Ce II	20	3268.21	Ru I
15	3260.01	Dy II	24 d	3263.89	Tb II	14	3268.34	Gd II
20	3260.05	Tb II	5	3264.06	Tb II	2.5	3268.42	Pt I
32	3260.11	Zr I	30	3264.09	Tm	15	3268.48	Re I
9	3260.14	Nb I	60	3264.40	Mo I	16	3268.52	Tb II
9	3260.18	Ta I	8	3264.44	Th II	30	3268.89	Re I
28	3260.23	Mn I	12 d	3264.55	Ru I	75	3268.99	Tm II
20	3260.30	Os I		3264.66	Ru I	22	3269.12	Dy II
28	3260.35	Ru I	19	3264.59	Nb I	65	3269.21	Os I
8	3260.48	Mo I	28	3264.71	Mn I	32	3269.41	Er II
28	3260.56	Nb II	260	3264.79	Er II	8	3269.48	Th II
6	3260.66	Nd II	6	3264.81	Zr II	110	3269.49	Ge I
5	3260.66	Tb II	24	3264.90	Tb II	30	3269.66	Zr I
13	3260.70	Dy II	36	3264.94	Sm II	3.0	3269.78	U II
16	3260.82	Co I	13	3265.12	Nd II	400	3269.91	Sc I
10	3260.83	Tb II	16	3265.14	Mo I	18	3270.12	U II
8	3260.92	Th II	10	3265.29	Hf I	14	3270.47	Nb I
18	3260.98	Ce II	3.0	3265.38	Nd II	15	3270.49	Sm II
32	3261.06	Cd I	4	3265.42	Ce II	8	3270.63	Tb II
13	3261.22	Dy II	8	3265.58	Th II	15	3270.68	Sm II
18	3261.50	Yb II	13	3265.62	Fe I	12	3270.76	Nb I
8	3261.54	Th II	75	3265.67	La II	8	3270.83	Th II
20	3261.56	Re I	14	3265.81	U	100	3270.90	Mo I
100	3261.60	Ti II	8	3265.93	Tb II	15	3271.00	Fe I
38	3261.65	Tm II	15	3266.00	Dy II	9	3271.12	Ni I
12	3261.72	U	18	3266.21	Dy II	120	3271.12	V II
20	3261.74	Tb II	9	3266.34	Ho II	24	3271.13	Zr II
5	3261.90	Hf I	11	3266.39	Eu II	9	3271.15	Ce II
20	3262.01	Ir I	42	3266.40	Tb II	3.0	3271.45	U
9	3262.20	Ho II	38	3266.44	Ir I	9	3271.55	Ce II
30	3262.28	Sm II	12	3266.44	Ru I	44	3271.61	Rh I
320	3262.29	Os I	26 d	3266.62	W I	12	3271.64	V I
550	3262.34	Sn I		3266.76	W I	26	3271.65	Ti II
13	3262.47	Hf I	9	3266.63	Er II	8	3271.78	Co I
38	3262.63	Mo I	150	3266.63	Tm II	4	3271.96	Ce
65	3262.67	Th II	55	3266.73	Gd I		3272.06	Ce II
10	3262.68	Tb II	12	3266.85	Re I	8	3272.05	Th I
40	3262.75	Os I	13	3267.00	Th II	24	3272.07	Nb I
12	3262.77	Re I	8	3267.01	Hf I	7	3272.08	Dy II
18	3262.81	Er II	9	3267.05	Nb I	26	3272.08	Ti II
26	3262.97	Tb II	42	3267.14	Er II	20	3272.16	Os I
8	3263.03	Th II	8	3267.18	Hf I	9	3272.22	Nb II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
85	3272.22 Zr II		22	3278.92 Ti II		9	3282.89 Dy II	
90	3272.25 Ce II		220	3278.97 Lu I		4	3282.96 Th II	
16	3272.35 Tb II		13	3279.01 Ce II		16	3283.08 Ho II	
36 d	3272.48 Sm II		30	3279.25 Ho II		55	3283.10 Tb II	
	3272.60 Sm II		200	3279.26 Zr II		8	3283.10 U	
18	3272.74 Dy II		9	3279.29 Ta I		12	3283.31 V I	
16	3272.77 Eu II		70	3279.33 Er II		9	3283.35 Ce II	
36	3272.81 Sm II		8	3279.44 Mo I		5	3283.38 Hf II	
10	3273.03 V I		9	3279.49 Dy II		110	3283.40 Tm II	
160	3273.05 Zr II		11	3279.53 Gd II		32	3283.46 Co I	
20	3273.08 Ru I		3.0	3279.55 U		24	3283.46 Nb II	
6	3273.18 Nd II		14	3279.67 Dy II		200	3283.57 Rh I	
7	3273.32 Sm II		4	3279.82 Cu I		6	3283.68 Ce II	
9	3273.33 Er II		18	3279.84 Ce II		5	3283.81 Tb II	
36	3273.48 Sm II		14	3279.84 V II		4	3284.22 Ce II	
500	3273.63 Sc I		30	3279.98 Hf II		7	3284.36 V I	
20	3273.66 Hf II		6	3280.00 U		7	3284.37 Dy II	
22	3273.89 Th II		80	3280.08 Dy II		8	3284.67 Tm II	
2500	3273.96 Cu I		70	3280.22 Er II		140	3284.71 Zr II	
11	3274.18 Gd II		80	3280.28 Tb II		3.0	3285.02 Mo I	
26	3274.19 Tb II		22	3280.37 Th II		110	3285.04 Tb II	
26	3274.33 Tb II		7	3280.49 Ce II		17	3285.10 Nd II	
20	3274.71 Ru I		200	3280.55 Rh I		16	3285.21 Tb II	
30	3274.86 Ce II		5500	3280.68 Ag I		30	3285.22 Ce II	
28	3274.95 Ta II		22	3280.84 Sm II		12	3285.22 U	
22	3275.06 Th II		9	3280.87 Ta I		4	3285.36 Mo I	
55	3275.20 Os I		40	3280.91 Y II		110	3285.61 Tm II	
19	3275.22 Nd II		7	3280.92 Os		16	3285.64 Re I	
7	3275.66 Tb II		4	3281.10 Ce		28	3285.66 Nb I	
11	3275.68 Ta II		13	3281.18 Ho II		15	3285.66 Sm II	
7	3275.87 Sm II		80	3281.40 Tb II		9	3285.75 Th I	
11	3275.89 Dy II		3.0	3281.49 Nd		22	3285.88 Zr II	
100	3276.12 V II		10	3281.61 Gd II		9	3286.03 Ce II	
13	3276.25 Ce II		7	3281.63 Dy II		18	3286.18 Er II	
6	3276.67 Pr II		9	3281.70 Rh I		36	3286.23 Sm II	
36	3276.75 Sm II		440	3281.74 Lu I		7	3286.54 Sm II	
100	3276.81 Tm II		18	3281.94 W I		8	3286.58 Dy II	
9	3277.16 Ho II		110 c	3281.97 Ho II		22	3286.58 Th II	
16	3277.28 Ir I		2.5	3281.97 Pt I		6	3286.62 Nd II	
22	3277.32 Tb II		26	3282.25 Gd I		7	3286.67 Os I	
10	3277.57 Ru I			3282.30 Gd II		28	3286.76 Fe I	
19	3277.67 Nb I		18	3282.33 Ti II		46	3286.77 Er II	
9	3277.70 Er II		20	3282.33 Zn I		5	3286.98 Tb II	
16	3277.71 Re I		7	3282.53 V II		6	3287.06 Ir I	
11	3277.73 Tb II		6	3282.54 U		8	3287.13 Re I	
22	3277.78 Eu II		11	3282.70 Ni I		5	3287.19 Co I	
34	3277.97 Os I		50 d	3282.73 Zr I		50	3287.25 Pd I	
44 c	3278.15 Ho II			3282.83 Zr II		8	3287.38 Mo I	
24	3278.22 Er II		3.0	3282.78 Nd II		9	3287.45 U	
17	3278.29 Ti II		44	3282.79 Dy II		32	3287.55 Tb II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
10	3287.59	Ir I	18	3293.71	W I	32	3298.66	Tb II
24	3287.59	Nb I	18	3293.83	Dy II	12	3298.74	V II
44	3287.66	Ti II	4	3293.84	Nd II	11	3299.06	U
44	3287.79	Th II	5	3293.93	Ta I	14	3299.41	Ti I
19	3287.92	Nb I	17	3293.94	Th II	19	3299.61	Nb I
18	3287.97	Dy II	11	3294.04	Tb II	9	3299.70	U
14	3287.97	Er II	44	3294.08	Gd I	16	3299.77	Ta I
18	3288.21	U	50	3294.11	Ru I	9	3299.99	Ce
44	3288.46	Ho II	18	3294.28	Rh I	20	3300.15	Ce II
12	3288.65	Dy II	10	3294.36	Nb II	18	3300.16	Nd II
24	3288.80	Zr II	5	3294.44	U	22	3300.46	Rh I
20	3288.84	Os I	4	3294.68	Nd II	4	3300.61	Th II
140	3289.02	Mo I	20	3294.83	Re I	90	3300.82	W I
24	3289.14	Rh I	16	3294.85	Mo I	7	3300.90	Dy II
2600	3289.37	Yb II	9	3294.99	Th II	8	3300.91	Nd II
12	3289.39	V II	22	3295.29	Ce II	8	3300.97	Re I
3.0	3289.52	Nd	13	3295.32	Th II	14	3300.98	Sm II
4	3289.64	Rh I	18	3295.33	Ta I	17	3301.26	Th II
24	3289.84	Mo I	22	3295.33	Tb II		3301.35	Th
9	3290.12	Th	4	3295.43	Cr II	14	3301.34	Ho I
12	3290.22	Pt I	30	3295.44	Sm II	800	3301.56	Os I
130	3290.26	Os I	9	3295.52	Th II	38	3301.59	Ru I
60 d	3290.28	Sm II	9	3295.53	Pr II	28	3301.60	Re I
	3290.39	Sm II	36	3295.81	Sm II	17	3301.63	Th II
9	3290.34	Ce II	38	3296.01	Nb I	28	3301.68	Sm II
4	3290.58	Ce II	6	3296.11	Ru I	3.0	3301.73	Sr I
6	3290.65	Nd II	13	3296.19	Ce II	50	3301.86	Pt I
15	3290.65	Sm II	18	3296.31	Dy II	9	3301.94	Er II
120	3290.82	Mo I	3.0	3296.39	Pr	16	3301.95	Eu II
30 c	3290.96	Ho II	13	3296.40	Mo I	400	3302.13	Pd I
220	3291.00	Tm II	12	3296.40	Zr II	24	3302.23	Re I
18	3291.05	Hf I	11	3296.60	Th II	30	3302.32	Na I
10	3291.06	Nb II	28	3296.70	Re I	190	3302.45	Tm II
9	3291.12	Dy II	4	3296.72	Rh I	90	3302.59	Zn I
9	3291.27	Er II	18	3296.88	Ce II	12	3302.67	Zr II
30	3291.34	U	10	3296.88	Mn I	28	3302.94	Zn I
44	3291.48	Gd I	28	3296.99	Re I	15	3302.99	Na I
32	3291.56	Tb II	13 c	3297.06	Ho II	110	3303.11	La II
65	3291.74	Th II	9	3297.36	Th II	3.0	3303.19	Pr
19	3292.02	Nb II	12	3297.62	Dy II	32	3303.21	Re II
24	3292.08	Ti I	17	3297.83	Th II	13	3303.34	Mo I
38	3292.21	Gd II	4	3297.89	U	9	3303.48	Th II
24	3292.31	Mo II	6	3297.96	Ru I	12	3303.60	U II
4	3292.48	Ta I	4	3298.04	Th	28	3303.75	Re I
44	3292.52	Th II	60	3298.10	Sm II	32 d	3303.95	Er II
160	3293.07	Tb II	10	3298.12	Ho II	9	3304.07	Er II
20	3293.37	Sm II	19	3298.14	V I	11	3304.10	Tb II
9	3293.58	Th II	11	3298.20	Tb II	22	3304.22	Mo I
4	3293.59	Ce II	10	3298.22	Mn I	34	3304.24	Th I
3.0	3293.59	U	4	3298.61	Nd	11	3304.26	Tb II

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
9	3304.38 Ta I		14	3308.05 Nb I		16	3312.53 Tb II	
5	3304.50 Eu II		8	3308.25 Re I		48	3312.60 Nb I	
28	3304.52 Sm II		18	3308.39 Ti I		9	3312.69 Ti I	
4	3304.66 Nd II		2.5	3308.47 Y II		46	3312.72 Dy II	
14	3304.83 Nb I		22	3308.51 Tb II		12	3312.75 Nd II	
22	3304.84 Ce II		40	3308.79 Dy II		16	3312.80 Tb II	
22	3304.95 Tb II		18	3308.81 Ti II		75	3312.86 Hf I	
85	3305.15 Zr II		100	3308.88 Dy II		4	3313.06 Th I	
22 c	3305.16 Ho II		9	3309.14 Th II		6	3313.16 Nd II	
28	3305.18 Sm II		11	3309.17 Tb II		6	3313.30 Ce II	
18	3305.27 Yb I		7	3309.18 V I		11	3313.30 Dy II	
4	3305.30 Th I		13	3309.19 Hf I		15	3313.33 Eu II	
5	3305.33 Nd		9	3309.27 Ce II		9	3313.49 Er II	
11	3305.37 Tb II		9	3309.36 Th I		13	3313.62 Mo II	
18	3305.40 Dy II		22	3309.50 Ti I		13	3313.64 Th II	
18	3305.51 Dy II		28	3309.52 Sm II		18	3313.66 Er II	
40	3305.56 Mo I		5	3309.73 Ti I		24	3313.70 Zr II	
36	3305.58 Er II		10	3309.78 Ta I		34	3313.73 Gd II	
20	3305.73 Yb II		110	3309.80 Tm II		12	3313.94 U	
16	3305.90 Mo I		6	3309.89 Zr II		24	3313.95 Re I	
44	3305.93 U II		5	3310.10 Tb II		9	3314.04 Ce II	
28	3305.97 Fe I		13	3310.24 Th II		12	3314.08 Co I	
20	3306.01 Tm II		38	3310.27 Hf I		5	3314.38 Pr II	
24	3306.12 Hf I		8	3310.37 Tb II		22	3314.38 Tb II	
22	3306.17 Ru I		6	3310.38 Nd II		70	3314.42 Ti I	
22	3306.19 Dy II		14	3310.47 Nb I			3314.52 Ti I	
26	3306.23 Os I		3.0	3310.50 U		18	3314.44 Er II	
140	3306.28 Zr II		16	3310.52 Ir I		34	3314.50 Zr II	
28	3306.35 Fe I		60	3310.60 Tm II		5	3314.70 Tb II	
140	3306.39 Sm II		70	3310.66 Sm II		22	3314.72 Ce II	
8	3306.41 Tb II		20	3310.77 Mo I		17	3314.80 Th II	
14	3306.61 Sm II		11	3310.80 Tb II		8	3314.95 Er II	
13	3306.63 Ce II		5	3310.86 Hf II		6	3315.05 Pt I	
14	3306.88 Ti I		8	3310.91 Nd II		6	3315.05 Ru I	
20	3306.91 Tm II		65	3310.91 Os I		11	3315.07 Tb II	
8	3307.01 Re I		9	3310.97 Dy II		7	3315.11 Yb II	
3.0	3307.02 Cr II		140	3311.16 Ta I		24	3315.22 Nb I	
70	3307.02 Sm II		10	3311.34 Nb I		30	3315.23 Ru I	
40	3307.12 Mo I		6	3311.34 Zr II		24	3315.32 Ti II	
8	3307.15 Co I		55	3311.38 W I		13	3315.42 Os I	
13	3307.23 Ce II		13	3311.50 Ce II		20	3315.59 Gd II	
44 d	3307.44 Tb II		12	3311.72 U II		16	3315.66 Ho II	
8	3307.46 Er II		360	3312.11 Lu I		60	3315.66 Ni I	
3.0	3307.55 U		8	3312.13 Ir I		10	3315.69 Os I	
9	3307.80 Tb II		18	3312.22 Ce II		6	3316.02 Nd II	
8	3307.95 Cu I		8	3312.29 Re I		9	3316.09 W I	
20	3308.01 Tm II		12	3312.33 Mo I		8	3316.17 Tm II	
22	3308.02 Ce II		14	3312.39 Ho II		8	3316.19 Hf I	
	3308.09 Ce II		220	3312.42 Er II		70	3316.34 Dy II	
15	3308.02 Eu II		50	3312.42 Sm II		55	3316.39 Er II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
30	3316.39 Ru I		5	3320.81 Nb II		45	3325.67 Mo I	
9	3316.56 Gd II		24	3320.90 Mo II		12	3325.90 Nd II	
34	3316.58 Sm II		60	3321.01 Be I		24	3326.18 Dy II	
10	3316.69 Os			3321.09 Be I		55	3326.19 W I	
38	3316.88 Tm II		9	3321.11 Ho II		4 h	3326.26 Nd	
22	3317.11 Dy II		36 d	3321.15 Tb II		6	3326.41 Zr I	
15	3317.52 Er II		100	3321.18 Sm II		8 d	3326.43 Dy II	
5	3317.58 Tb II		100	3321.34 Be I		7	3326.45 Th II	
4	3317.73 Th II		36	3321.44 Th II		3.5	3326.59 Cr I	
18	3317.80 Ce II		7 d	3321.54 V II		29	3326.62 Nb I	
6	3317.89 Ru I			3321.68 V I		32	3326.76 Ti II	
28	3317.93 Ta I		46	3321.70 Ti II		60	3326.80 Zr II	
20	3317.99 Hf II		10	3321.86 Eu II		22	3326.99 Co I	
28	3318.02 Ti II		4	3322.09 Th I		12	3327.08 Dy II	
9	3318.15 Dy II		9	3322.12 U II		11	3327.11 Tb II	
8	3318.24 Er II		15	3322.20 Co I		9	3327.18 Th II	
12	3318.51 Zr II		9	3322.26 Eu I		7	3327.30 Dy II	
9	3318.53 Ta I		44	3322.28 Tb II		45	3327.30 Mo I	
16	3318.67 Re I		28	3322.31 Ni I		32	3327.42 Os I	
9	3318.78 Er II		3.0	3322.46 U		6	3327.50 U	
6	3318.82 Ru I		60	3322.48 Re I		8	3327.58 Tm II	
	3318.91 Ru I		20	3322.60 Ir I		4	3327.66 Ce II	
90	3318.84 Ta I		8	3322.87 Ir I		3	3327.69 Nd	
3.0	3318.85 U II		240	3322.94 Ti II		28	3327.88 Sm II	
12	3318.96 Ce II		60	3322.99 Zr II		600	3327.89 Y II	
4	3318.97 Th II		360	3323.09 Rh I		6	3327.90 Ce II	
24	3318.98 Nb I		75	3323.20 Er II		15	3328.21 Hf II	
24	3319.02 Zr II		15	3323.21 Tm II		4	3328.25 Th II	
11	3319.16 Tb I		5	3323.36 Hf II		24	3328.28 Nd II	
6	3319.21 U II		22	3323.38 Tb II		4	3328.35 Cr II	
14	3319.26 Nb I		12	3323.74 Ho II		8	3328.79 Dy II	
6	3319.32 U		28	3323.77 Sm II		13	3329.00 Ce II	
11	3319.43 Yb I		3.5	3323.80 Pt I		13 c	3329.02 Ho II	
15	3319.48 Co I		22	3323.89 Tb II		8	3329.04 Mo I	
7	3319.56 Sm II		80	3323.95 Mo I		4	3329.05 Cr I	
14	3319.58 Nb II		7	3324.06 Cr II		55	3329.08 Tb II	
16	3319.59 Mo I		26	3324.33 Os I		13	3329.34 Gd II	
16	3319.79 Mo I		400	3324.40 Tb II		20	3329.36 Nb I	
22	3319.87 Ho II		5	3324.55 Pr II		180	3329.46 Ti II	
90	3319.88 Dy II		28	3324.75 Th II		7	3329.62 Sm II	
7	3319.89 Eu II		7	3324.93 Re I		28	3329.67 Er II	
36	3320.16 Sm II		10	3325.00 Ru I		4	3329.72 Th	
26	3320.25 Ho II		4	3325.06 Ce		14	3329.86 V I	
30	3320.26 Ni I		60	3325.12 Th II		12	3329.92 U	
20	3320.29 Th II		12	3325.24 Co I		3.0	3329.99 Sr I	
9	3320.37 W I		28	3325.26 Sm II		44	3330.34 Gd II	
4	3320.42 Ce II		16	3325.33 Ce II		7	3330.48 Ce	
19	3320.44 Gd II		14	3325.48 Sm II		18	3330.48 Th I	
9	3320.59 Sm II		16	3325.52 Tb II		110	3330.62 Sn I	
10	3320.69 Mn I		6	3325.66 U II		11	3330.67 Mn I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
44 d	3331.00	Ta	12	3335.42	Tb II	70	3341.00	Dy II
	3331.01	Ta I	12	3335.69	Ru I	4 bl	3341.31	Th ThO
5	3331.09	Rh I	14	3336.12	Sm II	12	3341.42	Dy II
4	3331.22	Ce II	100	3336.15	Os I	7	3341.43	Sm II
9	3331.23	Dy II	110	3336.18	Gd II	2.5	3341.47	Pr II
4	3331.24	Rh I	12	3336.33	Cr II	6	3341.48	Hg I
140	3331.38	Gd II	16	3336.51	Mo I	15	3341.60	Nb II
8	3331.40	Mo I	9	3336.68	Mg I	9	3341.62	Er II
20	3331.52	Re I	6	3336.68	U	24	3341.66	Ru I
15	3331.57	Nd II	26	3336.70	Tb II	18	3341.66	U II
55	3331.67	W I	8	3336.76	Er II	28	3341.85	Er II
5	3331.89	Hf I	9	3336.98	Gd II	22	3341.87	Ce II
22	3331.93	Ho II	34	3337.18	Yb II	24	3341.87	Dy II
4	3332.05	Ru I	70 c	3337.23	Ho II	480	3341.88	Ti I, II
46	3332.11	Ti II	36	3337.26	Er II	150	3341.97	Nb I
85	3332.13	Gd II	200	3337.49	La II	10	3342.15	Ti I
6	3332.15	Mg I	16	3337.79	U II	13	3342.23	La I
13	3332.16	Nb I	28	3337.80	Er II	160	3342.24	Re I
7	3332.40	Th II	9	3337.80	Ta I	14	3342.59	Cr II
11	3332.41	Ta I	7	3337.84	Cu I	12	3342.68	U
3.0	3332.42	U II	44	3337.87	Th II	9	3342.70	Ho II
7	3332.70	Sm II	32	3338.03	Tb II	10	3342.73	Co I
75	3332.71	Er II	200	3338.18	Re I	6	3342.90	Rh I
100	3332.73	Hf I	6	3338.37	Ir I	40 h	3342.94	Yb II
9	3333.04	Ce II	9	3338.39	Th II	5	3342.98	Tb II
7	3333.06	Yb II	30	3338.41	Zr II	4	3343.26	Th II
12	3333.13	Th I	6	3338.48	U II	10 d	3343.28	Sc II
18	3333.16	Ho II	11	3338.49	Ta I	4	3343.34	Cr I
11	3333.21	Tb II	28	3338.54	Rh I	4	3343.47	Ta I
14	3333.64	Sm II	5	3338.75	Eu II	20	3343.49	Sm II
9	3333.66	Ce II	44 c	3338.86	Ho II	110 c	3343.58	Ho II
13	3333.93	Tb II	26	3339.00	Tb II	9	3343.61	Th I
9	3334.06	Gd II	17	3339.07	Nd II	9	3343.64	Sm II
44	3334.14	Co I	17	3339.50	Dy II	15	3343.70	Er II
12	3334.14	Dy II	9	3339.51	Ce II	150	3343.71	Nb I
13	3334.16	Ir I	95	3339.55	Ru I	12	3343.72	Mo I
11	3334.25	Tb II	13	3339.61	Tb II	13	3343.77	Tb II
60	3334.25	Zr II	14	3339.68	Re I	22	3343.77	Ti II
100	3334.33	Eu I	12	3339.78	Co I	30	3343.86	Ce II
6	3334.44	Dy II	16	3339.80	Cr II	5	3343.93	Tb II
18	3334.46	Ce II	17	3339.91	Ta II	10	3343.96	Nb II
17	3334.48	Nd II	24	3340.03	Er II	7	3344.20	Rh I
22	3334.48	Tb II	30	3340.17	Mo I	80	3344.32	Re I
44	3334.61	Th II	95	3340.34	Ti II	20	3344.35	Sm II
34	3334.62	Zr II	7	3340.38	Y I	9	3344.37	Er II
7	3335.03	Sm II	18	3340.44	Ho II	22	3344.47	Ho II
9	3335.06	Th II	9	3340.49	Er II	6	3344.53	Ru I
8	3335.06	Tm II	120	3340.56	Zr II	120	3344.56	La II
150	3335.20	Ti II	70	3340.58	Sm II	160	3344.75	Mo I
16	3335.36	Re I	7 h	3340.89	Ce II	40	3344.76	Ce II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
7	3344.79 Ho II		360	3349.04 Ti II		20	3353.66 Zr I	
60	3344.79 Zr II		200	3349.06 Nb I		900	3353.73 Sc II	
9	3344.87 Th II		8	3349.07 Cr I		13	3353.91 Os	
6	3344.87 U		8	3349.19 Mo I		9	3353.95 Th II	
140	3345.02 Zn I		17 c	3349.21 Ta II		22	3354.18 Th II	
9	3345.09 W I		7	3349.32 Cr I		34 d	3354.18 Sm II	
4	3345.54 U		1000	3349.41 Ti II			3354.30 Sm II	
30	3345.57 Zn I		80	3349.42 Tb II		38	3354.38 Co I	
5	3345.71 Nd		50	3349.52 Nb I		4	3354.38 Eu II	
9	3345.86 W I		13	3349.97 Ce II		28	3354.39 Zr II	
7 bl	3345.89 Th ThO		22	3349.99 Tm I		18	3354.45 W I	
6	3345.89 U I		46	3350.06 Er II		11	3354.50 U	
6	3345.93 Zn I		20	3350.10 Gd II		36	3354.58 Ho II	
60	3345.98 Gd II		34	3350.27 Er II		5	3354.60 Nd II	
12	3346.02 Cr I		5	3350.28 Pr		14	3354.61 Th II	
130	3346.04 Er II		16	3350.30 Mo I		340	3354.64 Ti I	
32	3346.20 Re I		12	3350.40 Eu I		14	3354.72 Sm II	
5	3346.32 Tb II		550	3350.47 Gd II		40	3354.74 Nb I	
15	3346.35 Er II		40	3350.49 Ho II		22	3354.86 Tm II	
7	3346.35 Sm II		18	3350.88 Sm II		16	3354.99 Mo I	
12	3346.40 Mo II		12	3350.96 Ta I		18	3355.02 Ce II	
11	3346.50 Yb II		5	3351.08 Yb II		11	3355.07 Dy II	
9	3346.52 Ce II		70	3351.23 Th II		3.0	3355.11 U II	
13	3346.55 Th II		7	3351.24 Yb II		6	3355.23 Fe I	
28	3346.73 Ti II		4	3351.25 Sr I		9	3355.25 Th II	
12	3346.74 Cr I		18	3351.33 Er II		16	3355.29 Re I	
7	3346.91 Sm II		19	3351.44 Tb II		16	3355.67 Pr II	
15	3346.93 Nb I		17	3351.51 Ta I		12	3355.93 Nd II	
12	3346.94 Co I		4	3351.56 Eu II		10	3356.09 Hf II	
40	3347.02 Mo I		4	3351.60 Cr I		120	3356.09 Zr II	
22	3347.27 Tb II		11	3351.74 Os I		5	3356.18 Tb II	
14	3347.30 Sm II		7	3351.97 Cr I		17	3356.22 Dy II	
7	3347.53 Yb II		24	3352.05 Sc II		9	3356.22 Er II	
5	3347.56 Nd II		42	3352.06 Hf II		24 d	3356.33 Re I	
12	3347.64 Er II		36	3352.10 Ho II			3356.46 Re I	
18	3347.81 Dy II		9	3352.28 Ce II		12	3356.35 V I	
12	3347.84 Cr II		14	3352.49 Yb II		16	3356.41 Ce II	
16	3347.86 Er II		5	3352.59 Nb I		5	3356.55 Nd	
6	3347.89 Nd		24	3352.70 Dy II		14	3356.78 Hf I	
22	3348.07 Tb II		19	3352.89 Tb II		7	3356.82 Th II	
7	3348.11 Co I		16	3352.94 Ce II		9	3356.98 Ho II	
18	3348.14 Er II			3352.99 Ce II		15	3357.04 Nb I	
10	3348.17 Nd II		10	3352.94 Ti I		22	3357.22 Ce II	
9	3348.23 Tb II		7 h	3353.03 Cr I		85	3357.26 Zr II	
16	3348.54 Tb II			3353.13 Cr II		6 d	3357.30 Sc	
12	3348.61 Ho II		13	3353.21 Re I		13	3357.37 Tb II	
20	3348.68 Sm II		7	3353.33 Ce II		22	3357.61 Gd I	
6	3348.76 Er II		36 cw	3353.55 Ho II		36	3357.91 Ho II	
22	3348.77 Th I		46	3353.59 Dy II		11	3357.93 U II	
9	3348.96 Th II		19	3353.59 Nd II		24	3357.97 Os I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
20	3358.02 Re I		3361.73 Th II		30	3365.77 Ni I
200	3358.12 Mo I	23	3361.64 Ta I		12	3365.80 Dy II
18	3358.16 Er II	9	3361.67 Er II		100	3365.86 Sm II
12	3358.26 Dy II	6	3361.73 U		30	3366.17 Ni I
24	3358.28 Ti I	16	3361.76 Ce II		3.0	3366.33 Sr I
8	3358.30 Hf II	8	3361.77 Cr II		18	3366.52 Th II
200	3358.42 Nb I	10	3361.84 Ti I		22	3366.55 Ce II
28	3358.43 Gd II	150	3361.94 Sc II		6	3366.66 Ta I
5	3358.46 Tb II	6	3362.00 Ru I		16	3366.68 Hf I
30	3358.47 Ta I	20	3362.00 Y II		19	3366.70 Er I
22	3358.50 Cr II	5	3362.18 Rh I		6	3366.81 Ni I
44	3358.60 Th II	7	3362.18 Th II		40	3366.96 Nb I
17	3358.61 Dy II	7	3362.21 Cr I		36	3367.11 Co I
440	3358.62 Gd II	550	3362.23 Gd II		16	3367.18 Tb II
26	3358.91 Hf I	34	3362.25 Tb II		12	3367.27 Sm II
16	3359.22 Re I	16	3362.37 Mo I		10	3367.38 Nb I
2.5	3359.27 Pr	14	3362.43 Yb II		6	3367.56 U
22	3359.48 Dy II	9	3362.50 Th II		5	3367.64 Eu II
440	3359.56 Lu I	5	3362.53 Ta I		15	3367.66 Gd II
180	3359.68 Sc II	380	3362.62 Tm II		28	3367.81 Th II
10	3359.76 Nd II	5	3362.67 Th		24	3367.82 Zr II
11	3359.86 Tb II	15	3362.68 Zr II		6	3367.89 Ni I
5	3359.90 Rh I	20	3362.74 Re I		5	3367.90 U
28	3359.96 Zr II	7	3362.80 Co I		55	3368.05 Cr II
5	3360.05 Tb II	9	3363.06 Th II		140	3368.07 Er II
20	3360.06 Hf I	5 h	3363.25 Pr		46	3368.10 Dy II
6	3360.08 U	9	3363.34 W I		12	3368.33 Tm II
9	3360.15 Th II	13	3363.41 Ho II		9 c	3368.36 Ho II
5	3360.29 Tb II	7	3363.64 Yb II		36	3368.38 Rh I
20	3360.30 Cr II	9	3363.70 Th II		38	3368.45 Ru I
9	3360.37 Th II	120	3363.78 Mo I		55	3368.48 Ir I
24	3360.46 Zr I	24	3363.82 Zr II		28	3368.57 Sm II
18	3360.54 Ce II	140	3364.09 Er II		12	3368.60 Tm I
8	3360.64 Dy II	20	3364.12 Os I		4	3368.64 Zr I
80	3360.71 Gd II	28	3364.24 Gd II		5	3368.69 Ce II
24	3360.80 Rh I	11	3364.24 Tb II		4	3368.79 Ce
16	3360.87 Ho II	36	3364.27 Ho II		9	3368.83 U
24	3360.99 Ti I	9	3364.35 Ce II		360	3368.95 Sc II
15	3361.03 Er II	9	3364.36 Tb II		3.0	3368.98 U I
16	3361.14 Re I	18	3364.69 Th II		7	3369.04 Sm II
26	3361.15 Os I	7	3364.80 Sm II		15	3369.06 Eu II
20	3361.15 Ru I	80	3364.93 Tb II		15	3369.16 Nb II
600	3361.21 Ti II	16	3364.96 Nd II		8	3369.25 Mo I
	3361.26 Ti I	11	3365.29 Tb II		6	3369.26 Zr II
150	3361.27 Sc II	9	3365.33 Th I		15	3369.28 Ta I
32	3361.37 Mo I	14	3365.55 V I		28	3369.46 Sm II
7	3361.43 Sm II	15	3365.58 Nb II		8	3369.55 Fe I
7	3361.56 Co I	20	3365.59 Gd II		260	3369.57 Ni I
30	3361.56 Ni I	16 d	3365.73 Re I		15	3369.62 Gd II
22 d	3361.61 Th II		3365.84 Re I		15	3369.64 Tm II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
4	3369.68	Rh I	9	3373.49	Th I	44	3377.13	Ce II
8	3369.83	Nb I	18	3373.73	Ce II	9	3377.14	Rh I
11	3369.89	Ho II	48	3373.75	W I	6	3377.39	U II
5	3370.13	U II	10	3373.84	Gd I	7	3377.39	V I
13	3370.20	Os I	95	3374.16	Er II	24	3377.46	Zr II
5 d	3370.30	Pr	26	3374.16	Ho II	240 d	3377.48	Ti I
7	3370.33	Co I	24	3374.22	Ni I		3377.58	Ti I
95	3370.44	Ti I	5	3374.25	Nb II	14	3377.62	V I
44	3370.59	Er II	8	3374.28	Dy II	20	3377.66	Tb II
100	3370.59	Os I	5	3374.35	Ti II	7	3377.71	Rh I
14	3370.59	Sm II	8	3374.36	Ho II	24	3377.74	Re I
24	3370.59	Zr I	20	3374.41	Tb II	6	3377.81	Sm II
24 d	3370.61	Tb II	46	3374.51	Tm II	12	3378.02	Ru I
12	3370.79	Fe I	18	3374.58	Th II	8	3378.20	Dy II
14	3370.86	Dy II	12	3374.64	Ni I	16	3378.20	Mo I
32	3370.87	Ho II	13	3374.65	Ru I	3.0	3378.20	U
19	3371.05	W I	22	3374.69	Gd II	9	3378.30	Zr II
18	3371.17	Ce II	60	3374.73	Zr II	7	3378.34	Cr II
28	3371.21	Sm II	42	3374.92	Nb I	11	3378.40	Tb II
12	3371.29	U	18	3374.98	Th I	16	3378.42	Dy II
20	3371.33	Nb I	55	3375.03	Tb II	16	3378.46	Mo I
10	3371.35	W I	8	3375.22	Mo I	28	3378.58	Th II
360	3371.45	Ti I	5	3375.23	Nd II	13	3378.68	Os I
34	3371.50	Tb II	34	3375.48	Yb II	34	3378.73	Tb II
85	3371.54	Ta I	8	3375.65	Mo I	55	3378.86	Tb II
14	3371.69	Dy II	16	3375.75	Dy II	9	3378.88	Dy II
18	3371.79	Th II	7	3375.78	Ce II	20	3378.93	Hf I
14	3371.81	Dy II	9	3375.78	U	7	3379.01	Er II
10	3371.86	Ru I	8	3376.01	Dy II	32	3379.06	Re II
36	3371.99	Ni I	17	3376.05	Ta I	9	3379.15	Tb II
9	3372.01	U II	7	3376.06	V I	13	3379.17	Ce II
17	3372.08	Os I	9	3376.10	Er II	4	3379.17	Cr I
8	3372.09	Nb I	17	3376.27	Zr II	24	3379.22	Ti I
600	3372.15	Sc II	28	3376.33	La II	4	3379.37	Cr II
4	3372.21	Hf I	8	3376.34	Nb I	18	3379.52	Ta II
12	3372.21	Ti II	16	3376.36	Dy II	10	3379.60	Ru I
95	3372.25	Rh I	11	3376.36	Tb II	32	3379.70	Re I
55	3372.36	Tb II	4	3376.40	Cr I	22	3379.76	Gd II
11	3372.43	Ho II	12	3376.48	Sm II	5	3379.76	Pr II
5	3372.51	Pr II	6	3376.49	Ta II	12	3379.83	Cr II
8	3372.56	Nb II	360	3376.50	Lu I	9	3379.92	Zr I
48 d	3372.72	Tb II	5	3376.55	U	120	3379.97	Mo I
12	3372.75	Dy II	12	3376.62	Dy II	10	3380.01	Gd II
750	3372.76	Er II	7	3376.62	Yb II	5	3380.04	Tm II
8	3372.78	Tm I	5	3376.66	Pr	8	3380.05	Nb I
480	3372.80	Ti II	17	3376.66	Tb II	13	3380.18	Ru I
550	3373.00	Pd I	10	3376.73	Nb I	7	3380.25	Eu II
7	3373.23	Co I	5	3376.84	Th II	120	3380.28	Ti II
28	3373.42	Zr II	8	3377.00	Er II	32	3380.41	Nb I
18	3373.46	Ce II	14	3377.11	Dy II	9	3380.49	Ho II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
22	3380.52 Gd II		48	3385.05 Ta I		9	3389.46 Th I	
16	3380.53 Tm I		170	3385.08 Er II		10	3389.50 Ru I	
300	3380.57 Ni I		13	3385.14 Ru I		18 c	3389.56 Ho II	
17	3380.60 Tb II		60	3385.22 Co I		15	3389.62 Er II	
6	3380.70 U		5	3385.39 Sm II		22	3389.65 Th II	
65	3380.71 Sr II		55	3385.50 Lu I		44	3389.74 Er II	
22	3380.85 Ni I		22	3385.53 Th II		20	3389.80 Mo I	
16	3380.86 Nb I		14	3385.66 Ti I		90	3389.83 Hf II	
	3380.93 Nb II		20	3385.76 Re I		11	3390.02 Tb II	
9	3380.86 Th I		9	3385.78 Rh I		7	3390.24 Yb II	
9	3380.89 Tb II		8	3385.88 Mo I		20	3390.25 Re I	
200	3380.91 La II		20	3385.94 Os I		4	3390.32 Yb II	
13	3381.08 Er II		120	3385.95 Ti I		8	3390.36 Th II	
28	3381.32 Er II		9	3386.13 U		30	3390.39 U	
9	3381.35 Th II		9	3386.14 Os I		9	3390.52 Ce II	
9	3381.49 Ce II		19	3386.21 Hf I		22	3390.60 Tb II	
8	3381.56 Dy II		20	3386.24 Nb II		10	3390.63 Nb I	
6	3381.95 U		4	3386.29 Nd		12	3390.68 Ti I	
22	3382.06 Er I		9	3386.41 Ho I		32 c	3390.75 Ho II	
8	3382.29 Mo I		11 d	3386.49 Tb II		8	3390.78 Eu II	
14	3382.31 Ti I		22	3386.50 Th II		9	3390.88 Gd II	
100	3382.40 Sm II		6	3386.52 Nd II		5	3390.97 U	
40	3382.48 Mo I		19	3386.59 Dy II		120	3391.05 Ni I	
4	3382.58 Yb II		5	3387.46 Ta I		10	3391.10 W I	
18	3382.68 Cr II		20	3387.51 Yb I		7	3391.10 Yb II	
3.0	3382.68 U II		12	3387.66 Sm II		12	3391.11 Sm II	
34	3382.80 Tb II		12	3387.75 Mo I		13 d	3391.14 Dy II	
2800	3382.89 Ag I		10	3387.75 Nb I		40	3391.28 Tb II	
9	3383.14 Th II		7	3387.78 Ce II		5	3391.33 Nb I	
10	3383.15 Sb I		65	3387.84 Os I		12	3391.43 Cr II	
4	3383.38 Pr		120	3387.84 Ti II		10	3391.53 W I	
18	3383.69 Ce II		90	3387.87 Zr II		9 h	3391.55 Lu I	
5	3383.73 Pr		8	3387.91 Th I		8	3391.72 Tb II	
480	3383.76 Ti II		6	3388.03 Nd II		6	3391.89 Ru I	
10	3383.80 Nb I		5	3388.04 Pr		19	3391.98 Dy II	
8	3383.98 Fe I		70	3388.17 Co I		900	3391.98 Zr II	
32	3384.00 Os I		120	3388.30 Zr II		20	3391.99 Eu II	
9 h	3384.10 Dy II		9	3388.37 Tb II		220	3392.00 Er II	
16	3384.14 Hf II		8	3388.58 Th II		17	3392.01 Tb II	
16	3384.45 Re I		11	3388.59 Y I		90	3392.03 Th II	
9	3384.45 U II		6	3388.63 Tb II		18 c	3392.05 Ho II	
9	3384.60 Os I		13	3388.71 Ru I		12	3392.17 Mo I	
240	3384.62 Mo I		5	3388.76 Ti II		7	3392.31 Fe I	
10	3384.66 Nb I		5	3388.82 Ta I		4	3392.31 Nd	
42	3384.66 Sm II		10	3388.83 W I		42	3392.34 Nb I	
26	3384.70 Hf II		55	3388.87 Dy II		9	3392.47 Ho II	
12	3384.86 Sm		34	3389.32 Sm II		110	3392.53 Gd II	
40 d	3384.98 Tm II		4	3389.33 Nd		38	3392.54 Ru I	
	3385.09 Tm I		24	3389.43 Re I		15	3392.66 Fe I	
480	3385.03 Dy II		9	3389.44 Dy II		12	3392.71 Ti I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
26	3392.81 Hf I		30	3396.58 Eu II		11	3399.97 Tb II	
7	3392.99 Cr II		6	3396.66 Zr II		55	3399.99 Gd II	
300	3392.99 Ni I		3.5	3396.72 Ce II		19	3400.21 Hf I	
3.0	3392.99 U II		14	3396.73 Th I		4	3400.25 Ce II	
6	3393.01 Tb II		80	3396.82 Lu I		22	3400.40 V I	
90	3393.12 Zr II		28	3396.84 Er II		28	3400.53 Tb II	
16	3393.19 Tm I		480	3396.85 Rh I		12	3400.60 Ho II	
5	3393.23 Th II		6	3397.04 Y I		22 d	3400.86 Tb II	
8	3393.39 Dy II		240	3397.07 Lu II		12	3401.01 U	
17	3393.58 Tb II		3.0	3397.20 U		7	3401.02 Yb II	
340	3393.59 Dy II		55 c	3397.21 Bi I		11	3401.07 Gd II	
15	3393.63 Gd II		8	3397.21 Re I		13	3401.17 Os I	
17	3393.63 Nd II		22 d	3397.22 Gd I		8	3401.17 Re	
20	3393.65 Mo I			3397.32 Gd I		9	3401.21 Er II	
9	3393.84 Cr II		26	3397.26 Hf I		6	3401.21 U	
12 d	3393.91 U		12	3397.33 Ho II		22	3401.59 Ho II	
9	3393.92 Ce II		160	3397.50 Tm II		14	3401.68 Th II	
13	3394.00 Dy II		16	3397.52 Th I		32	3401.74 Ru I	
9	3394.12 Er II		26	3397.60 Hf I		38	3401.83 Er II	
8	3394.12 Re I		6	3397.60 Tb II		65	3401.86 Os I	
8	3394.13 Th II		20	3397.69 Mo I		3.0	3401.87 U	
6	3394.14 Ce II		12	3397.76 Sm II		10	3402.00 Dy II	
7	3394.30 Cr II		6	3397.87 Tm I		14	3402.02 Th II	
9	3394.39 Er II		6	3397.92 Zr I		55	3402.07 Gd II	
7 h	3394.44 Yb II		16	3398.02 Tm II		14	3402.18 Ho II	
95	3394.58 Ti II		10	3398.10 W I		44	3402.33 Tb II	
26	3394.59 Hf II		10	3398.25 Nb I		4	3402.40 Cr II	
7	3394.59 Os		6	3398.26 U		5	3402.42 Ti II	
36 c	3394.60 Ho II		19	3398.28 Er II		50	3402.46 Sm II	
13	3394.61 Pr II		30	3398.33 Ta I		20	3402.51 Hf I	
11	3394.77 Tb II		8	3398.35 Dy II		26	3402.51 Os I	
14	3394.78 U II		28	3398.35 Tb II		7	3402.57 V I	
9	3394.79 Th II		18	3398.53 Th I		70	3402.70 Th II	
19	3394.86 Er II		9	3398.58 Tb II		6	3402.78 Tb II	
16	3394.98 Hf II		5	3398.63 Ti I		16	3402.81 Mo I	
5	3394.98 Nb II		900 c	3398.98 Ho II		24	3402.87 Zr II	
17	3395.02 Tb II		3.0	3399.00 U		10	3403.02 Nb I	
55	3395.12 Gd II		34	3399.10 Tb II		11	3403.08 Gd II	
12	3395.32 U		400	3399.30 Re I		17	3403.09 Sm II	
16	3395.36 Mo II		9	3399.30 Tb II		13	3403.27 Dy II	
8	3395.37 Th II		8	3399.34 Dy II		14	3403.28 Th II	
140	3395.38 Co I		22	3399.34 Fe I		22	3403.32 Cr II	
12 d	3395.58 U		60	3399.35 Zr II		8	3403.35 Mo I	
10	3395.72 Os I		14	3399.40 Nb I		10	3403.45 Dy II	
20	3395.93 Nb I		20	3399.41 Gd II		12	3403.55 U	
34	3396.06 Er II		70	3399.70 Rh I		2.5	3403.57 Pr	
120	3396.17 Dy II		10	3399.71 Nb II		7	3403.60 Ce II	
34	3396.19 Sm II		260	3399.80 Hf II		80	3403.65 Cd I	
26	3396.33 Zr II		12	3399.84 Sm II		30	3403.68 Zr II	
9	3396.41 Th II		40	3399.95 Tm II		5	3404.11 Yb II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
3.5	3404.13 Ce		32	3408.38 Nb I		4	3412.39 Nd	
6	3404.24 Tb II		10 h	3408.38 W I		7	3412.45 Yb I	
80	3404.34 Mo I		18 d	3408.63 Th II		11	3412.47 Y I	
15	3404.36 Fe I			3408.75 Th I		32	3412.59 Tm I	
2600	3404.58 Pd I		24	3408.67 Re I		140	3412.63 Co I	
12	3404.63 Th II		28	3408.68 Nb II		13	3412.74 Os I	
17	3404.71 Tb II		70	3408.68 Sm II		17	3412.87 Ho II	
65	3404.72 Re I		18	3408.69 Er II		12	3412.89 Ta I	
90	3404.83 Zr II		45	3408.76 Cr II		28	3412.94 Nb II	
18	3404.91 Ce II		13	3408.76 Os I		19	3412.96 W I	
19	3404.98 Dy II		6	3408.78 Zr		18	3413.01 Th I	
9	3405.04 Gd II		9	3408.86 Tb II		23	3413.14 Fe I	
700	3405.12 Co I		22 c	3409.06 Ho II		22	3413.27 Gd II	
8	3405.20 Mo I		280	3409.18 Co I		30	3413.48 Ni I	
28	3405.41 Nb I		22	3409.19 Nb II		19	3413.54 W I	
14	3405.56 Th I		14	3409.26 Th II		10	3413.74 Hf II	
24	3405.65 Dy II		32	3409.28 Ru I		8	3413.74 Re I	
4	3405.75 U		26	3409.30 Gd II		55	3413.76 Tb II	
65	3405.89 Re I		9	3409.44 Dy II		120	3413.78 Dy II	
160	3405.94 Mo I		12	3409.58 Ni I		5	3413.81 U	
22	3405.98 Ce II		8	3409.81 Ti II		7	3413.90 Sm II	
20	3406.01 Tb II		32	3409.83 Re I		30	3413.94 Ni I	
16	3406.13 Nb I		15	3409.88 Er II		11	3414.07 Nb I	
9	3406.23 Th II		9	3409.91 Nb I		18	3414.14 Ta II	
13	3406.27 Ho II		17 d	3409.94 Tb II		22 c	3414.25 Ho II	
10	3406.28 Os		80	3410.05 Tm I		3.0	3414.36 U	
9	3406.28 U II		26	3410.17 Hf II		9	3414.51 Th II	
14	3406.55 Rh I		9	3410.25 Nd II		60	3414.66 Zr I, II	
22	3406.66 Ta II		120	3410.25 Zr II		32	3414.74 Co I	
10	3406.67 Os I		90 c	3410.26 Ho II		750	3414.76 Ni I	
10 h	3406.81 Dy II		22	3410.40 Tb II		48	3414.83 Dy II	
20	3406.92 Gd I		44 c	3410.65 Ho II		160 c	3414.90 Ho II	
60	3406.94 Ta I		22	3410.71 Tb II		3	3415.55 Nd	
7	3406.96 Er II		13	3410.72 Dy II		11	3415.68 Dy II	
4	3407.10 Tb II		22	3411.02 Gd I		8	3415.71 Pr I	
10	3407.14 Hf I		10	3411.21 Dy II		5	3415.88 Th II	
34	3407.16 Dy II		7	3411.30 Sm II		22	3415.97 Nb I	
5	3407.20 Ti II		10	3411.51 Dy II		3.0	3416.12 U	
4	3407.24 Ce II		12	3411.53 U		28	3416.24 Tb II	
30	3407.46 Fe I		32	3411.55 Ho II		600	3416.46 Ho II	
110 d	3407.56 Gd II		5	3411.57 Tm II		8	3416.56 Ce II	
	3407.61 Gd II		19	3411.64 Ru I		32	3416.59 Tm I	
16	3407.76 Hf II		12	3411.77 Th II		8	3416.68 Sc I	
480	3407.79 Dy II		6 h	3411.79 Zr I		13	3416.86 Ce II	
5	3407.82 Th I		11	3412.02 Gd II		140	3416.95 Gd II	
6 d	3407.91 U		12	3412.10 U		6	3417.03 Ta II	
30	3408.08 Zr II		70	3412.27 Rh I		7	3417.06 V I	
34	3408.13 Pt I		420	3412.34 Co I		24	3417.15 Dy II	
38	3408.14 Dy II		7	3412.34 Hf I		170	3417.16 Co I	
22	3408.21 Ho II		6	3412.36 U		18	3417.28 Er II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
13	3417.33 Gd II		16	3420.75 Re I		24	3424.60 Mo I	
26	3417.34 Hf I		8	3420.81 Dy II		800	3424.62 Re I	
320	3417.35 Ru I		2.5	3421.11 Pr		11	3424.66 Tb II	
26	3417.45 Ce II		28	3421.20 Rh		12	3424.76 Mo I	
34	3417.64 Er II		26	3421.21 Cr II		10	3424.78 Sm II	
9	3417.72 Tb II		28	3421.21 Th I		6	3424.81 U	
32	3417.77 Re I		1400	3421.24 Pd I		25	3424.82 Zr II	
15	3417.84 Fe I		24	3421.25 Mo I		16	3425.02 Eu II	
11	3417.86 Nb I		14	3421.32 Dy II		48	3425.06 Dy II	
7	3417.90 Ce II		5	3421.42 Hf II		15	3425.07 V I	
6	3417.91 Tb II		130	3421.63 Ho II		26	3425.08 Er II	
24	3418.13 Dy II		13	3421.69 Os I		600	3425.08 Tm II	
22	3418.15 Sm II		9	3421.69 U		9	3425.15 Th II	
9 c	3418.19 Ho II		16	3421.80 Tm I		12	3425.19 Mo I	
3.0	3418.39 U I		32	3422.31 Mo I		11	3425.22 Nd II	
20	3418.40 Yb I		3.0	3422.35 U		7	3425.34 Ce II	
13	3418.47 Ho I		19	3422.43 W I		220 c	3425.34 Ho II	
8	3418.47 Pr II		20	3422.44 Tb II		8	3425.35 Dy II	
15	3418.51 Fe I		700	3422.47 Gd II		28	3425.42 Nb II	
12	3418.51 Sc I		7	3422.51 Ce II		16	3425.48 Mo I	
36	3418.51 Sm II		12	3422.58 Dy II		90	3425.63 Tm II	
30	3418.52 Mo I		14	3422.65 Th II		16	3425.85 Nb I	
6	3418.52 V I		8	3422.66 Fe I		6	3425.92 Tb II	
140	3418.73 Gd II		55	3422.71 Ce II		40	3425.93 Gd II	
14	3418.77 Th II		34	3422.74 Cr II		6	3425.94 Ce II	
6	3418.86 Tb II		40	3422.75 Gd II		9	3425.94 Th II	
9	3418.93 Ce		24	3422.86 Dy II		16	3426.00 Mo I	
14	3418.94 Th II		19	3422.87 Er I		50	3426.06 Yb I	
6	3418.95 Tb II		8	3423.05 Tb II		40	3426.19 Re I	
6	3418.96 Mo I		9	3423.05 U		14	3426.20 Sm II	
12	3419.11 Zr II		7	3423.09 Eu II		36	3426.21 Ce II	
19	3419.17 Th II		9	3423.11 Th II		10	3426.34 Gd II	
46	3419.18 Hf I		10	3423.25 Dy II		7	3426.39 Fe I	
4	3419.24 Pr II		150	3423.71 Ni I		7	3426.39 U	
6	3419.36 Sc I		22	3423.76 Nb I		5	3426.44 Eu II	
80	3419.41 Re I		8 h	3423.82 Dy II		28	3426.57 Nb II	
6	3419.42 Ir I		10	3423.85 Ce II		7	3426.58 Ce II	
9	3419.54 Tb II		110	3423.90 Gd I		7	3426.64 Fe I	
70	3419.63 Dy II			3423.92 Gd II		12	3426.73 Ta I	
18	3419.66 Zr I		11	3423.96 Tb II		26	3426.76 Ho II	
10	3419.75 Ta I		19	3423.99 Th I		20	3426.79 Mo I	
14	3419.77 Sm II		32	3424.11 Ho I		4	3426.93 Zr I	
5	3419.84 Eu II		16	3424.29 Fe I		32	3427.12 Fe I	
32	3420.04 Mo I		20 d	3424.35 Tb II		16	3427.44 Hf I	
7	3420.08 Ru I		10 d	3424.38 Rh I		7	3427.44 Os I	
5	3420.16 Rh I		19	3424.45 Ta I		28	3427.45 Nb I	
13	3420.18 Ce II		6	3424.50 Tm I		5	3427.59 Pr	
19	3420.18 Er II		14	3424.51 Co I		30	3427.61 Re I	
42 d	3420.34 Tb II		24	3424.56 U II		16	3427.67 Os I	
11	3420.63 Nb II		85	3424.59 Gd II		19	3427.72 W I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
10	3427.90 Mo I		6	3431.50 Ce II		700	3434.89 Rh I	
3.5	3427.93 Pt I		6	3431.54 U II		5	3434.91 Tm II	
7	3427.97 Sm II		18	3431.57 Zr II		8	3434.92 Tb II	
220 c	3428.13 Ho II		160	3431.58 Co I		5	3435.05 Eu II	
11 d	3428.16 Tb II		2.5	3431.62 Pr		16	3435.19 Ru I	
8	3428.20 Fe I		24	3431.79 Dy II		7	3435.20 Ce I	
5	3428.23 Co I		9	3431.80 Th II			3435.21 Ce II	
500	3428.31 Ru I		6	3431.86 Tb II		7	3435.20 Eu II	
22	3428.37 Hf II		36 c	3432.10 Ho II		6	3435.20 U	
48	3428.41 Er II		10	3432.21 Ru I		7	3435.26 Os I	
22	3428.47 Gd II		11	3432.35 Tb II		8	3435.27 Dy II	
11	3428.47 Yb II		22	3432.41 Zr II		5	3435.27 Sm II	
16	3428.62 Tm II		5	3432.42 Nb I		18	3435.35 Tm I	
13	3428.63 Ru I		20	3432.57 Dy II		3	3435.43 Nd	
6	3428.71 Tb II		22	3432.70 Nb II		40	3435.45 Mo I	
5	3428.79 Nb I		32	3432.74 Ru I		24	3435.49 U I	
10	3428.93 Nd II		12	3432.86 Dy II		8	3435.53 Tb II	
14	3429.00 Th I		12	3432.87 Mo I		48	3435.56 Sc I	
10 h	3429.01 Dy II		11	3432.90 Tb II		16	3435.61 Ho II	
16	3429.04 Nb I		70	3432.99 Gd II		4	3435.72 Eu II	
6	3429.09 Tb II		6	3432.99 Nd		12	3435.92 Dy II	
70 c	3429.18 Ho II		280	3433.04 Co I		55	3435.98 Th II	
18	3429.21 Sc I		16	3433.09 Ce II		19	3436.00 Ta I	
32	3429.33 Tm I		9	3433.09 Nb I		12	3436.07 Dy II	
8	3429.39 Th II		26	3433.12 Er II		20	3436.19 Cr I	
38	3429.45 Dy II		19	3433.26 Ru I		18	3436.31 Ho II	
18	3429.48 Sc I		34	3433.26 Tb II		19	3436.71 Th II	
19	3429.54 Ru I		18	3433.31 Cr II		650	3436.74 Ru I	
28	3429.60 W I		550	3433.45 Pd I		6	3436.78 U	
8	3429.75 Sm II		10 h	3433.55 Pr II		8	3436.95 Dy II	
9	3429.88 Th II		240	3433.56 Ni I		11	3436.96 Nb II	
19	3429.91 Er II		34	3433.60 Cr I		9	3436.97 Tb II	
80	3429.97 Tm II		14	3433.68 Sm II		65	3437.02 Ir I	
2.0	3430.18 U		3.0	3433.71 U II		9	3437.02 Th II	
11	3430.24 Gd II		6	3433.90 U II		32	3437.04 Ho I	
10	3430.28 Pr II		18	3433.91 Zr II		12	3437.10 Sm II	
10	3430.29 Zr I		70	3434.00 Th II		60	3437.14 Zr II	
12	3430.32 Ce II		12	3434.04 Mo I		80	3437.22 Mo I	
3.0	3430.48 U		7	3434.11 Cr I		90	3437.28 Ni I	
5	3430.51 Pr		11	3434.15 U II		24	3437.31 Th I	
160	3430.53 Zr II		170	3434.37 Dy II		10	3437.50 Ir I	
22	3430.61 Tb II		10	3434.50 Ta I		8	3437.64 Tm II	
50	3430.77 Ru I		6	3434.54 Tb II		10	3437.65 Er II	
24	3430.94 Ta I		5	3434.61 U		32	3437.71 Re I	
15	3430.98 Gd II		6	3434.62 Yb II		7	3437.81 Ce I, II	
14	3431.06 Er I		14	3434.64 Er II		14 c	3437.91 Ho II	
6	3431.14 U I		9	3434.74 Th		3.0	3437.93 U	
34	3431.14 Yb I		16	3434.76 Ho II		14	3438.06 Sm II	
40	3431.20 Tm II		3.5	3434.76 Pr		750	3438.23 Zr II	
24	3431.36 Sc I		48	3434.79 Mo I		28	3438.24 Hf II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
16	3438.32 Er II		18	3441.44 Cr I		18	3445.66 Ho	
7 c	3438.35 Ho II		32	3441.44 Mo I		11	3445.68 Nb I	
26	3438.37 Ru I		120	3441.45 Dy II		14	3445.73 Th II	
6	3438.40 Ta		460	3441.50 Tm II		9	3445.91 Ta I	
16	3438.43 Hf I		8	3441.68 Tb II		16	3446.08 Mo II	
8	3438.47 Er II		11	3441.79 Gd II		7	3446.09 Co I	
20	3438.57 Tb II		11	3441.84 Hf I		440	3446.26 Ni I	
7	3438.71 Yb II		110	3441.99 Mn II		22	3446.40 Tb II	
13	3438.81 Tm II		13	3442.38 Ce II		8	3446.55 Tm I	
14	3438.85 Yb II		10 h	3442.52 Dy II		30	3446.61 Zr I	
32	3438.87 Mo I		8	3442.58 Th I		8	3446.72 Ce II	
5	3438.91 Co I		3	3442.63 Rh I		26	3446.88 Er I	
24	3438.95 Th II		38	3442.65 Er I		5	3446.89 Yb II	
30	3438.96 Dy II		8	3442.65 Nb I		10 c	3446.91 Ta II	
8	3439.05 Tb II		8	3442.66 Mo I		75	3447.00 Dy II	
170	3439.21 Gd II		3.5	3442.76 Pr		4	3447.02 Cr I	
5	3439.30 Ti I		4	3442.79 Nb I		400	3447.12 Mo I	
12	3439.32 Dy II		100	3442.93 Co I		16 d	3447.26 Tm II	
5	3439.40 Th I		11	3442.95 U			3447.35 Tm I	
8	3439.41 Sc I		6	3442.96 Ce II		15	3447.27 Dy II	
10	3439.49 Os I		6	3442.97 Re I		5	3447.28 Fe I	
28	3439.72 Tb II		16	3443.00 Tm I		12	3447.29 Ta I	
38	3439.72 Th II		30	3443.01 W I		3.0	3447.32 U	
85	3439.78 Gd II		5	3443.11 Th II		95	3447.36 Zr I	
13	3439.83 Ce II		32	3443.26 Mo I		22	3447.43 Cr I	
11	3439.92 Nb II		6	3443.32 Nd II		10	3447.53 Er II	
280	3439.99 Gd II		8	3443.46 Dy II		10	3447.74 Rh I	
6	3440.18 Sc		19	3443.57 Zr II		9	3447.76 Cr I	
22	3440.20 Ru I		5	3443.59 Yb II		15	3447.78 Dy II	
12	3440.24 Ta II		550	3443.64 Co I		4 h	3447.84 Pr I	
55	3440.37 Tb II		10	3443.72 Er II		16	3448.07 Er II	
8	3440.45 Dy II		4	3443.79 Cr I		5	3448.21 Pr II	
28	3440.45 Zr I		40	3443.88 Fe I		5	3448.29 Hf I	
20	3440.50 Sm II		5	3444.00 Th II		6	3448.49 Sc I	
120	3440.53 Rh I		8	3444.16 Tm I		5	3448.58 Rh I	
22	3440.59 Nb II		12	3444.26 Dy II		6	3448.78 U	
26	3440.60 Os I		75	3444.31 Ti II		26	3448.82 Y II	
400	3440.61 Fe I		13	3444.46 Os I		10	3448.83 W I	
5	3440.82 Eu II		34	3444.58 Tb II		16	3448.95 Ru I	
50	3440.94 Dy II		7	3444.62 Sm II		40	3448.97 Ir I	
6	3440.98 U		12	3445.04 Mo I		14 c	3449.01 Ho II	
80	3440.99 Fe I		16	3445.15 Fe I		80	3449.07 Mo I	
16	3441.00 Eu II		6	3445.15 Ta I		260	3449.17 Co I	
9	3441.01 Th II		5	3445.18 Eu II		32	3449.20 Os I	
9	3441.12 Cr I		14	3445.21 Th II		5	3449.28 Th II	
75	3441.15 Er II		24	3445.26 Mo I		44	3449.35 Ho I	
26	3441.21 Ce II		5	3445.38 Th II		40	3449.37 Re I	
8	3441.25 Re I		17	3445.55 Os I		130	3449.44 Co I	
9	3441.36 Th II		340	3445.58 Dy II		28	3449.46 Tb II	
700	3441.40 Pd I		22	3445.62 Cr I		6	3449.56 Sm II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
40	3449.62 Gd II		6	3453.78 U		8	3458.15 Mo I	
12	3449.65 Th II		12 c	3453.85 Ho II		10	3458.17 U	
16	3449.76 Tm II		85	3454.06 Tb II		26 d	3458.28 Yb II	
5	3449.83 Pr II		70	3454.07 Yb II			3458.36 Yb I	
12	3449.85 Mo I		55	3454.14 Gd II		13	3458.38 Os I	
40	3449.90 Dy II		7	3454.20 Th II		460	3458.47 Ni I	
10	3450.22 Dy II		13	3454.22 Mo I		13	3458.55 Tm I	
10	3450.29 Rh I		13	3454.23 U		3.0	3458.68 U	
11	3450.30 Tb II		240	3454.35 Dy II		20	3458.71 Tb II	
8	3450.33 Fe I		3	3454.38 Nd II		16	3458.88 Re I	
140	3450.38 Gd II		40	3454.52 Dy II		32	3458.93 Zr II	
8	3450.94 Th II		4	3454.81 Ce I		9	3458.95 Nb I	
9	3450.95 Y I		90	3454.90 Gd II		10	3458.99 Dy II	
5	3451.15 Rh I		7	3454.97 Sm II		14	3459.20 Sm II	
6	3451.21 U II		7	3455.03 Os I		10	3459.42 Sm II	
110	3451.23 Gd II		34	3455.22 Rh I		11	3459.70 Nb I	
3.0	3451.48 Pr		20	3455.27 Gd I		20	3459.92 Mo I	
7	3451.56 Ce II		11	3455.35 Tb II		15	3459.92 U	
9	3451.70 Th II		5	3455.42 Rh I		4	3460.16 Ce II	
16	3451.23 Ho I		65	3455.23 Co I		7	3459.83 Ce II	
38	3451.75 Mo I		16	3455.60 Cr I		16	3460.23 Mo I	
1600 c	3451.88 Re I		90 c	3455.70 Ho II		50	3460.27 Yb I	
8	3451.92 Fe I		10	3455.74 U		55	3460.33 Mn II	
18	3452.13 La II		32	3455.91 Zr I		40	3460.38 Tb II	
8	3452.28 Fe I		6	3455.97 Pr		20	3460.40 Dy II	
11	3452.31 Hf I		6	3455.99 Tb II		13	3460.43 Cr I	
11	3452.35 Nb II		1800 c	3456.00 Ho II		5500 c	3460.46 Re I	
	3452.37 Nb I		24	3456.15 Mo I		10	3460.64 Dy II	
11	3452.37 Tb II		5	3456.36 Tm I		3.0	3460.66 Pr	
12	3452.41 Yb I		120	3456.39 Mo I		850	3460.77 Pd I	
5	3452.47 Ti II		15	3456.39 Ti II		8	3460.78 Mo I	
32	3452.60 Mo I		9	3456.54 Nb I		400	3460.97 Dy II	
19	3452.68 Th II		11	3456.55 Tb II		20	3461.00 Tb II	
7	3452.78 Sm II		120	3456.57 Dy II		14	3461.02 Th I	
120	3452.89 Ni I		7	3456.62 Ru I		26	3461.09 Zr I	
10	3452.90 Ru I		4	3456.67 Ce II		20	3461.14 Sm II	
8 h	3453.02 Tm I		9	3456.77 Ce II		13	3461.16 Tm II	
360	3453.14 Ho II		7	3456.93 Co I		19	3461.18 Co I	
24	3453.17 La II		17 h	3457.03 Tb II		9	3461.18 La I	
8	3453.28 Re I		20	3457.05 Gd II		19	3461.22 Th I	
24	3453.33 Cr I		9	3457.05 Eu I		8	3461.29 Dy II	
8	3453.46 Tb II		13	3457.05 U II		9	3461.34 Ce II	
1300	3453.50 Co I		15	3457.07 Rh I		16	3461.36 Ho II	
24	3453.50 Re I		18	3457.18 Zr I		14	3461.38 Eu II	
8	3453.51 Th I		24	3457.45 Sc I		18	3461.40 Er II	
14	3453.56 Sm II		5	3457.56 Eu II		50	3461.50 Ti II	
15	3453.57 U		65	3457.56 Zr II		460	3461.65 Ni I	
460	3453.67 Tm II		13	3457.71 U		4	3461.79 Ce II	
16	3453.68 Er I		11	3457.79 Nb I		3	3461.83 Nd	
5	3453.74 Cr I		19	3457.93 Rh I		22	3461.95 Gd II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character		Wave-length in A	Element and Spectrum	Intensity and Character		Wave-length in A	Element and Spectrum	Intensity and Character		Wave-length in A	Element and Spectrum
180		3461.97	Ho II	5		3466.75	Pr	8		3469.85	Tb II
500		3462.04	Rh I	40		3466.83	Mo I	95		3469.92	Th II
16		3462.19	Sc I	8		3466.92	Tb II	6		3469.94	Zr II
800		3462.20	Tm II	34		3466.95	Gd II	12		3470.18	Dy II
13		3462.21	U I	8		3466.97	Mo I	17		3470.36	Tb II
5		3462.36	Yb I	5		3467.02	Cr I	4		3470.41	Ce II
24		3462.58	Er I	4		3467.04	Pr	400		3470.66	Rh I
16		3462.64	Hf II	40	c	3467.07	Ho II	14	c	3470.76	Ho II
6		3462.65	Nb I	8		3467.26	Ti I	7		3470.86	Nd II
7		3462.69	Sm II	170		3467.27	Gd II	24		3470.92	Mo I
320		3462.80	Co I	11		3467.47	Nb I	10		3471.13	Sc I
24		3462.85	Th II	18		3467.50	Ni I	50		3471.14	Dy II
24	d	3462.97	Tb II	20		3467.51	Tm I	12		3471.19	Nb I
22		3463.00	Gd II	16		3467.60	Hf I	95		3471.19	Zr I
130		3463.02	Zr II	80		3467.66	Cd I	12		3471.21	Th I
7		3463.14	Ru I	9		3467.72	Cr I	6		3471.38	Co I
9		3463.22	Ce II	4		3467.78	Ce II	50	d	3471.53	Dy II
10		3463.25	W I	32		3467.85	Mo I			3471.61	Dy II
17		3463.36	Dy II	8		3467.86	Dy II	95		3471.72	Er II
19		3463.54	U	14		3467.87	Sm II	28		3471.73	Tb II
19		3463.72	Th II	9		3467.88	Eu I	5		3471.95	Th I
9		3463.76	Ce II	14		3467.88	Y II	10		3472.25	Rh I
20		3463.81	Nb I	40		3467.96	Re I	26	c	3472.31	Ho II
18		3463.88	Dy II	65		3468.03	Tb II	28		3472.37	Tb II
31		3463.97	Ta I	15		3468.08	Gd II	80		3472.40	Hf I
280		3463.98	Gd II	9		3468.11	Ce II	280		3472.48	Lu II
10		3464.07	Sm II	9		3468.13	Ho I	16		3472.51	U
16		3464.21	Ce II	28		3468.22	Th II	6		3472.52	Ta I
340		3464.36	Yb I	10		3468.40	W I	150		3472.54	Ni I
6		3464.43	Sm II	7		3468.42	Nd II	6		3472.56	U II
95		3464.46	Sr II	65		3468.44	Dy II	16		3472.72	Re I
26		3464.53	Er II	8		3468.78	Dy II	2		3472.76	Cr I
6		3464.63	Tb II	7	d	3468.89	Ce II	85	d	3472.82	Tb II
4000	c	3464.73	Re I			3469.00	Ce II	4		3472.90	Zr I
5		3465.03	Th	170		3468.99	Gd II	3		3472.91	Cr I
8		3465.25	Cr I	40		3469.22	Mo I	22		3473.00	Tb II
13		3465.44	Os I	8		3469.31	Gd II	17		3473.02	Nb I
15		3465.63	Zr I	12		3469.34	Th	9		3473.03	Th II
13		3465.76	Pr II	16		3469.40	Ho II	140		3473.22	Gd II
32		3465.77	Th II	15		3469.44	Nb I	8		3473.22	Mo I
320		3465.80	Co I	48		3469.48	Er I	6		3473.28	Tb II
60		3465.86	Fe I	22		3469.49	Ni I	7		3473.41	Th II
22		3465.86	Nb I	6		3469.49	U	13		3473.43	U
9		3465.92	Th II	6		3469.59	Cr I	5		3473.61	Cr I
11		3465.98	Tb II	15		3469.62	Rh I	34		3473.70	Dy II
250		3466.20	Cd I	8		3469.63	Mo I	26		3473.75	Ru I
26		3466.30	U I	12	d	3469.65	Sc I	8		3473.79	Tb II
10		3466.50	Gd II	11		3469.70	Tb II	8		3473.85	Pr II
19	d	3466.52	Th I	26		3469.74	Er II	6		3473.90	Ta I
		3466.64	Th I	5		3469.78	U II	90	c	3473.91	Ho II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
11	3473.96 Sm II		4	3478.56 Co I		10	3481.82 W I	
500	3474.02 Co I		34	3478.69 Nb I		10	3482.09 Dy II	
55 h	3474.04 Mn II			3478.78 Nb II		13	3482.11 Os I	
	3474.13 Mn II		32	3478.79 Zr I		13	3482.14 Ce II	
7	3474.22 Ce II		70	3478.84 Yb II		7	3482.23 Os I	
600 c	3474.26 Ho II		180	3478.91 Rh I		24	3482.23 Re I	
20	3474.30 Dy II		5	3478.92 Ti I		22	3482.35 Ce II	
6	3474.54 U		22	3478.99 Hf II		24	3482.40 Mo I	
400	3474.78 Rh I		28	3479.02 Zr II		28	3482.54 U	
12	3474.89 Sr II		5	3479.16 U		9	3482.55 Th II	
6	3474.99 U		18	3479.17 Th II		7	3482.57 Yb II	
24	3475.03 Mo I		54	3479.28 Hf II		50	3482.60 Gd II	
80	3475.45 Fe I		6	3479.29 Tb II		9	3482.76 Th II	
6	3475.58 Nb I		190	3479.39 Zr II		8	3482.80 Tb II	
9	3475.68 Ce II		22	3479.43 Mo I		30	3482.81 Zr I	
6	3475.72 Tb II		60	3479.44 Er II		44	3482.91 Mn II	
10	3475.84 W I		11	3479.53 Sm II		30	3483.01 Zr I	
11	3476.12 Tb II		24	3479.56 Nb II		24	3483.04 Tb II	
11	3476.29 Tb II		9	3479.61 Ce II		13	3483.16 Ru I	
15	3476.31 Gd II		5	3480.05 Th I		13	3483.29 Ru I	
70	3476.31 Yb II		13	3480.09 Mo I		6	3483.41 Co I	
24	3476.44 Re I		40	3480.17 Tb II		6	3483.43 Pt I	
6	3476.44 U		11	3480.26 Sm II		120	3483.54 Zr II	
8	3476.46 Ir I		13 d	3480.27 Ce II		12	3483.67 Mo I	
12	3476.53 Th II			3480.38 Ce II		24	3483.69 Tb II	
32	3476.69 Tm I		15	3480.36 U		50	3483.77 Ni I	
32	3476.70 Fe I		40	3480.38 Re I		24	3483.84 Mo I	
44	3476.84 Ce II		24	3480.41 Zr II		9	3483.89 Ho II	
120	3477.06 Dy II		8	3480.42 Dy II		8	3484.04 Rh I	
8	3477.07 Eu I		28	3480.44 Er II		12	3484.05 Nb II	
8	3477.14 Re I		65	3480.52 Ta I		8	3484.48 Ir I	
50	3477.18 Ti II		20	3480.53 Ti I		10	3484.56 Er II	
6	3477.22 Ta I		14	3480.56 Sm II		6	3484.62 Ta I	
7	3477.45 Ce II		20	3480.83 Dy II		20	3484.67 Dy II	
13	3477.45 Ta I		32	3480.85 Re I		12	3484.74 Ce II	
3.0	3477.50 U		7	3480.98 Ce II		700	3484.84 Ho II	
5	3477.70 Th		32	3480.98 Tm I		7 h	3484.88 Nd I	
22	3477.75 Ho II		6	3481.05 Nb I		65	3485.05 Ce II	
6	3477.77 Ir I		1100	3481.15 Pd I		19	3485.17 Er II	
11	3477.84 U		200	3481.15 Zr II		14	3485.20 Th II	
8	3477.94 Dy II		7	3481.16 Ce II		16	3485.27 Pt I	
10	3477.94 Er II		220	3481.28 Gd II		20	3485.32 Zr II	
20	3477.95 W I		9	3481.30 Cr I		6	3485.34 Fe I	
22 c	3478.06 Ho II		24	3481.30 Ru I		24	3485.37 Co I	
9	3478.12 Th II		9	3481.44 Nd II		5	3485.69 Ti I	
20	3478.30 Zr II		9	3481.50 Tb II		22	3485.73 Y I	
9	3478.46 Th II		7	3481.54 Cr I		12	3485.76 Yb II	
8	3478.47 Dy II		32	3481.75 Tm II		95	3485.82 Er II	
10	3478.50 Zr II		13	3481.79 Mo I		22 c	3485.87 Ho II	
13	3478.53 Os I		170	3481.80 Gd II		12	3485.89 Ni I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
17	3485.90	Dy II	40	3491.05	Ti II	7	3495.37	Zr I
15	3485.92	V II	7	3491.07	Rh I	5	3495.38	Cr II
30	3485.93	Mo I	8	3491.24	Tb II	3.0	3495.60	U II
6	3485.93	Nb I	30	3491.32	Co I	5	3495.62	Os
22	3486.20	Gd I	5	3491.34	U	150	3495.69	Co I
5	3486.30	U	6	3491.48	Nb I	9	3495.70	Th I
18 c	3486.34	Ho II	10	3491.50	Os I	28	3495.75	Hf II
28	3486.50	Th II	3.0	3491.53	Pr	3.0	3495.75	U
	3486.54	Th I	5	3491.57	Th II	5	3495.75	Ti I
34	3486.83	Er II	5	3491.72	Tm I	22	3495.84	Mn II
16	3487.08	Tm II	11	3491.74	Gd II	13 c	3495.90	Re I
12	3487.21	Dy II	16 d	3491.77	Mo I	5	3495.92	Sm II
7	3487.25	Os I		3491.87	Mo I	14 hw	3495.92	Yb II
12	3487.28	Tb II	3.0	3491.94	Pr II	9	3495.93	Hf II
40	3487.38	Tm I	100	3491.95	Gd II	9	3495.94	Ce II
14	3487.41	Sm II	22 d	3492.00	Tb II	13	3495.97	Ru I
13	3487.46	Os	7	3492.11	Ho I	9	3496.03	Nb I
5	3487.57	Hf II	14	3492.54	Er II	220	3496.09	Y II
6	3487.57	Pr II	17	3492.56	Tb II	6	3496.20	Tb II
15	3487.59	Dy II	20	3492.58	Tm II	650	3496.21	Zr II
9	3487.62	Tb II	7	3492.62	Sm II	7	3496.33	Ce II
12	3488.42	Yb II	500	3492.96	Ni I	50	3496.33	Dy II
16	3488.55	Ce II	12	3492.99	Tb II	22	3496.42	U II
28	3488.68	Mn II	65 c	3493.09	Ho II	30	3496.68	Co I
6	3488.82	U	8	3493.11	Ce II	8	3496.81	Mn II
10	3488.97	Dy II	7	3493.17	V II	5	3496.81	Th I
9	3489.09	Nb II	16	3493.33	U	34	3496.87	Er II
26	3489.36	Er I	16	3493.34	Mo I	5	3497.01	Th II
65	3489.37	U I	19	3493.52	Th II	12	3497.03	V II
300	3489.40	Co I	9	3493.60	Ho I	9	3497.09	Gd I
6	3489.47	V I	14	3493.61	Sm II	8	3497.11	Fe I
30 d	3489.51	Tb II	9	3493.72	Ce II	8	3497.12	Dy II
12	3489.52	Tm I	14	3493.99	U I	28	3497.16	Hf I
9	3489.57	U II	20	3494.14	Dy II	5	3497.26	Th
55	3489.58	Ho II	28	3494.21	Tb II	6	3497.26	U
5	3489.74	Ti II	13	3494.25	Ru I	110	3497.49	Hf I
220	3489.77	Pd I	3.0	3494.30	Pr	16	3497.54	Mn II
12	3489.78	Tb II	170	3494.40	Gd II	6	3497.62	U
13	3490.13	Ce II	9	3494.44	Rh I	9	3497.65	Ho II
12	3490.24	U	400	3494.49	Dy II	24	3497.81	Nb I
5	3490.26	Th II	8	3494.72	Re I	36	3497.82	Dy II
13	3490.33	Os	280 c	3494.76	Ho II	24	3497.84	Fe I
5	3490.45	Th II	13	3494.84	U	50	3497.85	Ta I
80	3490.58	Fe I	17	3494.93	Tb I	14	3498.00	Th II
12	3490.63	Dy II	7	3494.97	Cr I	17	3498.54	Os I
6	3490.74	Co I	7	3495.01	Ce II	9	3498.62	Th I
11	3490.86	Re I	8	3495.19	Tm II	60	3498.63	Nb I
10	3490.93	Ta I	50	3495.25	W I	75	3498.67	Dy II
32 c	3490.95	Ho II	6	3495.29	Fe I	100	3498.73	Rh I
28	3491.03	Nb I	28	3495.36	Tb II	90 c	3498.88	Ho II

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
18	3498.91 Sc I		56	3503.06 Re I		10	3507.09 Sm II	
20	3498.94 Dy II		24	3503.18 Dy II		240	3507.32 Rh I	
850	3498.94 Ru I		12	3503.20 Nb I		32	3507.34 U I	
9	3498.95 Th I		8	3503.21 Gd II		480 c	3507.39 Lu II	
	3498.99 Th II		12	3503.36 Tm I		60	3507.45 Tb II	
11	3498.98 Hf I		10	3503.61 Th II		7	3507.67 Zr II	
7	3499.09 Pr II		5	3503.78 Th I		5	3507.69 Ni I	
8	3499.10 Ti I		32	3503.87 Ta I		12	3507.82 Yb II	
650	3499.11 Er II		13	3504.00 U		19	3507.95 Ce II	
10	3499.33 U II		10	3504.04 Tb II		55	3507.96 Nb I	
17	3499.34 Tb I		6	3504.27 Pr		14	3507.99 Ho I	
6	3499.57 Pr II		100	3504.41 Mo I		70	3508.12 Mo I	
30	3499.58 Zr II		28	3504.44 V II		6	3508.21 Pr	
13 d	3499.82 Dy II		75	3504.52 Dy II		38	3508.40 Er II	
	3499.92 Dy II		65	3504.66 Os I		95	3508.42 Lu I	
18	3499.84 Sm II		15	3504.75 Tb II		8	3508.47 Ce II	
32	3499.95 Tm I		75	3504.89 Ti II		6	3508.71 Ce II	
14	3499.98 Th II		6	3504.93 U		20	3508.74 W I	
26	3500.07 U I		17	3504.98 Ta I		19 d	3508.81 Er	
17	3500.27 Tb II		26	3505.07 Er II			3508.94 Er	
3.0	3500.33 U		13	3505.07 U		13	3508.85 U II	
14	3500.54 Sm II		12	3505.09 Tb II		5	3509.09 Th I	
5	3500.68 Ce		10	3505.18 Ta I		11	3509.10 Sm II	
5	3500.82 V I		140	3505.23 Hf II		600	3509.17 Tb II	
85	3500.84 Tb II		8 h	3505.30 Eu II		160	3509.32 Zr I	
60	3500.85 Ni I		30	3505.32 Mo I		36	3509.37 Ho II	
3.0	3501.00 U		5	3505.41 Rh I		16	3509.67 U	
50	3501.11 Ba I		8	3505.43 Ho II		180	3509.84 Co I	
26	3501.16 Os I		75	3505.45 Dy II		10	3510.00 La II	
20	3501.35 Zr I		6	3505.45 U		20	3510.03 W I	
15	3501.45 Ce II		10	3505.48 Th II		40	3510.10 Tb II	
36	3501.45 Dy II		55	3505.48 Zr II		24	3510.26 Nb II	
10	3501.46 Th II		140	3505.51 Gd II		240	3510.34 Ni I	
13	3501.49 Zr I		130	3505.67 Zr II		90	3510.43 Co I	
10 h	3501.58 Gd II		7	3505.69 V I		32	3510.46 Zr II	
20	3501.86 Dy II		28	3505.70 Er I		10	3510.54 Cr I	
5	3501.94 Th II		6	3505.81 Nb I		5	3510.69 Ce II	
20	3502.09 Dy II		24	3505.84 Dy II		7	3510.70 Nd II	
10 d	3502.24 U		28 d	3505.90 Tb II		90	3510.73 Ho I	
600	3502.28 Co I		13	3506.05 Zr II		13	3510.78 Mo I	
7	3502.42 Ru I		4	3506.25 Ce II		50	3510.84 Ti II	
10	3502.50 Ta I		440	3506.32 Co I		50 c	3510.85 Bi I	
500	3502.52 Rh I		6	3506.50 Fe I		65	3511.04 Ta I	
6	3502.60 Ni I		8	3506.56 Tb II		10	3511.04 Tb II	
36	3502.62 Co I		10	3506.64 Ti I		8	3511.16 Th I	
8	3502.73 Re I		120	3506.81 Dy II		10	3511.19 Nb I	
14	3502.77 Th II		10	3506.85 Sm II		28	3511.23 Sm II	
60	3502.78 Er I		5	3506.85 Th II		10	3511.44 U I	
17	3502.87 Ta I		46 c	3506.95 Ho II		48 d	3511.56 Th II	
8	3503.06 Pr II		10	3507.05 U I			3511.67 Th II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
6	3511.58 U II		6	3516.20 Nb I		32	3520.29 Yb II	
26	3511.69 Dy II		6	3516.3 U		19	3520.52 Ce II	
18	3511.76 Ho II		7	3516.30 Sm		8 c	3520.72 Re I	
5	3511.84 Cr II		7	3516.63 Os I		8	3520.79 U	
80	3512.22 Gd II		17	3516.64 Tb I		20	3520.87 Zr II	
5	3511.78 Rh I		10	3516.36 Th II		17	3520.79 Tb II	
10 c	3512.28 Re I		32	3516.65 Re I		4	3520.98 Ce II	
110	3512.50 Gd II		9	3516.78 Gd II		5	3521.06 Th I	
26	3512.56 Dy II		10	3516.83 Th II		50 cw	3521.09 Eu II	
17	3512.60 Tb II		6	3516.85 U		17	3521.13 Dy II	
300	3512.64 Co I		10	3516.86 Nb I		36	3521.26 Fe I	
26	3512.70 Dy II		1300	3516.94 Pd I		60	3521.41 Mo I	
10	3512.74 Th II		7	3517.02 Yb I		5	3521.48 U	
10	3512.93 La II		6	3517.05 U II		10	3521.53 Y I	
14 d	3512.93 Sm II		10	3517.14 La III		6	3521.56 Hf I	
	3513.06 Sm II		50	3517.27 Dy II		170	3521.57 Co I	
46	3512.99 Os I		75	3517.30 V II		30	3521.88 Ce II	
24	3513.02 Tm II		32	3517.33 Re I		10	3521.91 W I	
5	3513.10 Rh I		55	3517.38 Ce II		24	3521.92 Th II	
34	3513.10 Tb II		16	3517.56 Mo I		40	3522.03 Ir I	
17	3513.28 Hf I		24	3517.60 Tm I		7	3522.05 Nd II	
6	3513.37 U		24	3517.67 Nb II		8	3522.28 Dy II	
240	3513.48 Co I			3517.76 Nb I		8	3522.37 Mo I	
26	3513.61 Ta I		13	3517.72 Tm I		16	3522.43 Tm II	
320	3513.64 Ir I		10	3517.89 Gd II		9	3522.45 Gd II	
85	3513.65 Gd I		38	3518.17 Er II		20	3522.52 Er I	
13	3513.68 U		16	3518.22 Mo I		6	3522.58 U	
13	3513.70 Mo I		300	3518.35 Co I		6	3522.67 U	
11	3513.79 Ce II		5	3518.37 Ce II		26	3522.86 Dy II	
	3513.86 Ce		10	3518.40 Th I		6	3522.92 Tb II	
40	3513.82 Fe I		32	3518.72 Os		110	3523.02 Hf I	
10	3513.86 Os I		15	3518.75 Hf II		11	3523.12 Sm II	
30	3513.86 Tb II		5	3518.89 Th II		6	3523.20 Tb II	
24	3513.93 Ni I		17	3518.96 Tb I		3.0	3523.35 U	
6	3514.07 La I		14	3519.08 Ce II		240	3523.43 Co I	
8	3514.12 Tm I		2000	3519.24 Tl I		5	3523.53 Th II	
65	3514.49 Ru I		5	3519.54 Rh I		10	3523.57 U	
14	3514.52 Th II		320	3519.60 Zr I		50	3523.64 Os I	
65	3514.61 U I		34	3519.64 Ru I		140	3523.66 Tb II	
8	3514.86 Tm I		10	3519.76 Dy II		400	3523.98 Dy II	
48	3514.91 Er II		60	3519.76 Tb II		8	3524.07 Ce II	
5	3514.96 Th II		60	3519.77 Ni I		100	3524.20 Gd II	
30	3515.04 Tb II		46 c	3519.94 Ho II		13	3524.23 Mo I	
600	3515.05 Ni I		16	3519.96 U		750	3524.54 Ni I	
5	3515.24 U		12	3520.00 Os		8	3524.54 Re I	
24	3515.42 Nb II		20	3520.02 V II		15	3524.61 Dy II	
12	3515.44 Tb II		24	3520.06 Nb I		24	3524.65 Mo I	
460 c	3515.59 Ho II		20	3520.08 Co I		15	3524.72 V II	
22	3515.95 Ir I		24 c	3520.16 Ho II		8	3524.92 Dy II	
22	3516.14 Tb II		5	3520.25 Ti II		60	3524.92 Er II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
30	3524.98 Mo I		15	3530.02 Ce II		24	3534.85 Tm II	
8	3525.03 Tm I		24	3530.06 Os I		400	3534.96 Dy II	
40	3525.14 Tb II		14	3530.22 Zr I		34	3535.16 Zr I	
10	3525.14 U		8	3530.52 Th I		240	3535.30 Nb I	
11	3525.15 Gd I		26	3530.60 Sm II		10	3535.37 Ru I	
10	3525.23 Nb I		30	3530.77 V II		26	3535.41 Ti II	
6	3525.28 Tm I		11	3530.85 Zr II		160	3535.52 Tm II	
7	3525.51 Sm II		11	3530.87 Hf I		110	3535.54 Hf II	
46	3525.61 Tb II		8	3530.95 Ce II		20	3535.55 W I	
10	3525.65 U		16	3531.11 U II		8	3535.57 Ce II	
3.0	3525.73 U		8	3531.15 Eu II		22	3535.65 Sm II	
24	3525.75 Dy II		11	3531.23 Hf I		240	3535.73 Sc II	
17	3525.79 Tb II		10	3531.27 Er		13	3535.83 Ru I	
70	3525.81 Zr II		13	3531.39 Ru I		3.0	3535.84 U	
18	3526.04 Fe I		10	3531.44 Th I		500	3536.03 Dy II	
13	3526.04 Os I		20	3531.58 Ta I		46	3536.21 Tm II	
13	3526.17 Fe I		8	3531.59 Ce II		10	3536.30 Ta I	
10	3526.60 U		10	3531.64 U		46	3536.32 Tb II	
12	3526.61 Dy II		2000	3531.70 Dy II		26	3536.56 Dy II	
5	3526.64 Th I		22	3531.70 Tb II		20	3536.56 Fe I	
19	3526.68 Ce		5 h	3531.71 Nd II		80	3536.58 Tm II	
9	3526.73 Tb II		55	3531.85 Mn I		85	3536.62 Hf I	
26	3526.81 Er I			3532.00 Mn I		9	3536.62 Tb	
400	3526.85 CO I		10	3531.92 Th II		10	3536.70 Ce II	
20	3526.85 W I		170	3532.12 Mn I		7	3536.77 Sm II	
17	3526.92 Dy II		5	3532.21 Ta I		18	3536.94 Zr II	
7	3527.06 Ta I		5	3532.23 Eu II		3.0	3537.06 U	
12	3527.53 Nd II		18	3532.57 Sm II		24	3537.11 Tb II	
11	3527.85 Ce II		8	3532.61 Ce II		6	3537.13 Ce	
10	3527.98 Ni I		17	3532.70 Tb II		15	3537.15 Gd II	
750	3528.02 Rh I		17	3532.76 Ho I		14	3537.15 Th II	
6	3528.05 Ce II		24	3532.80 Os I		80	3537.28 Mo I	
44	3528.54 Gd II		24	3532.81 Ru I		10	3537.28 U	
130	3528.60 Os I		8	3532.88 Ce II		3.0	3537.31 Pr	
10	3528.61 Ta I		8	3533.20 Fe I		10	3537.44 Ce II	
4	3528.64 Ce		70	3533.22 Zr I		6	3537.44 U	
20	3528.68 Ru I		120	3533.36 Co I		20	3537.45 W I	
10	3528.69 U		13	3533.41 Os I		32	3537.46 Re I	
10	3528.82 Th II		26	3533.57 U II		150	3537.48 Nb I	
5	3528.93 Dy II		10	3533.59 Nd II		26	3537.69 Dy II	
19	3528.95 Th II		12	3533.66 Nb I		12	3537.69 Tb	
18	3529.02 Dy II		75	3533.68 V I		40	3537.91 Tm I	
170	3529.03 Co I		15	3533.86 Tb II		60	3537.94 Tb II	
4	3529.04 Ce II		55	3534.05 Ce II		40	3537.95 Ru I	
6	3529.21 Re I		6	3534.12 Nb I		7	3538.08 Eu II	
500	3529.43 Tl I		10	3534.24 Gd II		75 d	3538.14 Rh I	
30	3529.74 V I		13	3534.33 U I			3538.26 Rh I	
12	3529.76 Tb II		14	3534.44 Ce II		5	3538.23 U I	
3.0	3529.77 U		13	3534.46 Dy II		400	3538.50 Dy II	
460	3529.81 Co I		12	3534.82 Re I		6	3538.79 Ce II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum
24	3538.89	Ho II
15	3538.90	Tb
7	3539.01	Zr II
70	3539.09	Ce II
24	3539.32	Th II
16	3539.33	Re I
14 c	3539.35	Ho
36	3539.36	Dy II
80	3539.37	Ru I
60 d	3539.57	Er
48	3539.59	Th II
10	3539.62	Dy II
12	3539.65	Nb I
10	3539.65	U
15	3539.81	Tb
6 h	3539.92	Pr II
6	3539.94	Re I
120	3540.24	Tb II
22	3540.46	U II
14	3540.67	Dy II
70	3540.76	Ho II
7	3540.82	Ta I
30	3540.96	Nb II
24	3541.09	Fe I
22	3541.41	Ho I
11	3541.60	Nd II
10	3541.62	Th II
20	3541.63	Ru I
4	3541.66	Ce II
12	3541.75	Tb
13	3541.88	Ta II
3.0	3541.89	U
12	3541.90	Nb I
7	3541.91	Os I
24	3541.91	Rh I
22	3542.08	Fe I
5	3542.08	Tm I
16	3542.15	Eu II
40	3542.17	Mo I
150	3542.32	Dy II
4	3542.39	Pr
7	3542.46	Sm II
5	3542.50	Th I
6	3542.56	Nb I
13	3542.57	U I
100	3542.62	Zr II
24	3542.71	Os I
55	3542.77	Gd II
8	3542.87	Dy II
11	3542.98	Nb I
24	3542.99	Er
10	3543.16	U II
30	3543.23	Tb II
17	3543.26	Co I
8	3543.28	Ce II
17	3543.35	Nd II
15	3543.50	V I
4	3543.52	Ce II
5	3543.73	U
9	3543.85	Eu II
85	3543.86	Tb II
100	3543.95	Rh I
60	3544.02	Nb I
13	3544.02	Th I
6	3544.21	U
36	3544.23	Dy II
36	3544.36	Dy II
10	3544.36	Tb II
30	3544.65	Nb I
6	3544.99	U
5	3545.00	Th I
18 d	3545.18	Th II
	3545.29	Th II
75	3545.20	V II
80	3545.23	W I
6	3545.40	Tb II
10	3545.44	U
19	3545.60	Ce II
10	3545.67	U
7	3545.71	Yb II
15	3545.78	Ce II
440	3545.80	Gd II
26	3545.84	Er
5	3545.96	Th I
6	3546.01	Y II
180	3546.05	Ho II
8	3546.05	Tb II
10	3546.13	U
26	3546.19	Ce II
30	3546.52	Tb
10	3546.68	U II
130	3546.84	Dy II
14	3547.00	Ce II
16	3547.03	Ti I
16	3547.19	U II
10	3547.34	Th I
26	3547.51	Er
10	3547.53	Dy II
280	3547.68	Zr I
200	3547.80	Mn I
8	3547.89	Dy
170	3548.03	Mn I
3.0	3548.09	Pr
12	3548.13	Nb I
30	3548.18	Ni I
30	3548.19	Dy II
60	3548.20	Mn I
30	3548.23	Er
6	3548.44	Co I
13	3548.48	Tm II
18	3548.53	Ho
6	3548.62	U II
13	3548.72	Dy II
20	3548.81	Hf I
12	3548.82	Tb
6	3548.84	Ce II
500	3549.01	Y II
16	3549.05	Ta I
13	3549.20	U I
6	3549.21	Tb
12	3549.26	Dy II
6	3549.26	Nb I
400	3549.36	Gd II
16	3549.36	Tb II
20	3549.51	Zr II
3.0	3549.53	Pr
150	3549.54	Rh I
20	3549.55	Er
12	3549.60	Th I
5	3549.71	Eu II
34	3549.74	Zr I
14	3549.82	Yb II
80	3549.85	Er
24	3549.89	Re I
8	3550.16	Tm II
6	3550.17	U
400	3550.22	Dy II
13	3550.27	Ru I
5	3550.29	Th II
36	3550.45	Nb I
100	3550.46	Zr I
34	3550.60	Co I
9 c	3550.60	Ho
15	3550.64	Cr I
6	3550.82	La II
48	3550.82	U II
8	3550.83	Tm II
32 d	3551.03	Tb
6	3551.04	U
17	3551.12	Dy II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
16	3551.29 Re I			3555.10 Th II		16	3558.94 Re I	
10	3551.40 Th I		5	3555.20 Pr		24	3558.96 Zr I	
6 d	3551.41 Pr I		17	3555.29 Tb		32	3558.99 Ir I	
8	3551.43 Ce		28	3555.32 U I		5	3559.00 Yb I	
5	3551.53 Ni I		8	3555.43 Mo I		8	3559.03 Ho	
200	3551.59 Dy II		5	3555.71 Th I		42	3559.10 Sm II	
11	3551.66 Ce II		12	3555.77 Nd II		6	3559.12 Nb I	
	3551.78 Ce II		20	3555.82 Tm I		6	3559.14 Tb	
8	3551.68 Tm I		12	3555.96 Dy II		40	3559.27 Dy II	
14	3551.79 Er		10	3555.97 Os I		30	3559.39 Tb I	
17	3551.80 Y I		10	3556.04 Er		38	3559.45 Th II	
280	3551.95 Zr II		6	3556.05 Tb		24	3559.76 Tb II	
34	3551.96 Tb II		12	3556.25 Tb		100	3559.79 Os I	
3.0	3551.96 Pr		7	3556.25 V I		100	3559.89 Er II	
5	3552.07 Ce II		16	3556.37 Er		19	3559.95 Th II	
13	3552.17 U		8	3556.58 Tm I		26	3560.13 Dy II	
10	3552.30 Sm II		340	3556.60 Zr II		46	3560.15 Ho II	
19	3552.52 Eu II		10	3556.63 Ru I		7	3560.27 Sm II	
6	3552.67 U		14	3556.74 Sm II		6	3560.31 U	
70	3552.69 Y I		120 c	3556.78 Ho II		28	3560.33 Yb II	
60	3552.70 Hf II		10	3556.80 Er		6	3560.44 U II	
22	3552.73 Ce II		75	3556.80 V II		7	3560.60 V II	
3.0	3552.92 U		6	3556.89 Ce		24	3560.71 Yb II	
6	3552.99 Co I		140	3557.05 Gd II		24	3560.75 Nd II	
1300	3553.08 Pd I		20	3557.07 Er		110	3560.80 Ce II	
14	3553.11 Th II		16	3557.17 Ir I		130	3560.86 Os I	
30	3553.18 Er II		9	3557.26 La II		70	3560.89 Co I	
8	3553.19 Dy II		8	3557.34 Tm I		32	3560.92 Tm I	
15	3553.27 V I		14	3557.38 Sm II		13	3561.41 U	
5	3553.38 Th II		12	3557.47 Th II		4	3561.54 Ce II	
7	3553.42 Ta I		10	3557.62 Dy II		14	3561.59 Sm II	
6	3553.44 U		3.0	3557.70 Pr		4	3561.61 Nd II	
16	3553.65 Re I		40	3557.80 Tm II		150	3561.66 Hf II	
9	3553.72 Gd II		16	3557.84 U I		340	3561.74 Tb II	
6	3553.74 Fe I		7	3557.98 Ta I		6	3561.75 Ni I	
13	3553.85 Ru I		150	3558.02 Er		5	3561.78 Th I	
4	3553.99 Nd		8	3558.09 Tb		48	3561.80 U	
17	3554.00 Hf I		65	3558.10 Mo I		8	3562.09 Ce II	
20	3554.07 Zr II		9 c	3558.15 Ho		5	3562.22 Pr	
20	3554.15 Sm II		55	3558.19 Gd II		13	3562.34 Os I	
12	3554.20 Mo I		40 h	3558.21 Dy II		5	3562.55 Pr	
10	3554.21 W I		44	3558.47 Gd II		50	3562.90 Tb II	
20	3554.29 Er		10	3558.52 Cr I		200	3563.14 Dy II	
280	3554.43 Lu II		65	3558.52 Fe I		50	3563.14 Mo I	
30	3554.52 Nb I		600	3558.55 Sc II		8	3563.37 Th I	
10	3554.63 Ce		3.5	3558.71 Ce II		18 c	3563.45 Ho	
120	3554.66 Nb I		50	3558.72 Er		20	3563.49 Er	
28	3554.93 Fe I		22	3558.76 Y I		75	3563.50 Nb I	
38	3554.99 Ce II		48 d	3558.77 Tb		75	3563.62 Nb I	
14 d	3555.02 Th I		6	3558.78 Co I		16	3563.66 U I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
50	3563.69	Dy II	14	3568.14	Zr II	5	3571.56	U
8	3563.76	Mo I	16	3568.23	Re I	8	3571.57	Th II
10	3563.82	Ce II	350	3568.27	Sm II	12	3571.65	V I
40	3563.88	Tm I	6	3568.51	Nb II	8	3571.68	Dy II
7 h	3563.94	Yb II	440	3568.51	Tb II	6	3571.69	U II
20	3564.05	Gd II	3.0	3568.67	Pr	20	3571.85	Ta I
20	3564.13	Rh I	12	3568.72	Nb I	90	3571.87	Ni I
5	3564.18	U	18	3568.79	Ho	70	3571.93	Gd II
20	3564.24	Dy II	6	3568.82	U	34	3572.07	Tb II
17	3564.31	Hf I	20	3568.87	Nd II	24	3572.39	Th II
13	3564.56	Ru I	34	3568.88	Zr I	11	3572.43	Ce
10	3564.59	U	7	3568.94	V I	340	3572.47	Zr II
9	3564.64	Gd II	170	3568.98	Tb II	10	3572.48	W II
5	3564.72	Th II	120	3569.04	Hf II	7	3572.50	Yb II
8	3564.73	Re I	22	3569.06	U	1200	3572.53	Sc II
7	3564.79	Ta I	20	3569.25	Er	110	3572.74	Pb I
6	3564.88	U	8	3569.32	Ce II	34	3573.08	Zr II
55	3564.95	Co I	550	3569.38	Co I	14	3573.22	Th II
6	3565.05	U I	22	3569.47	Nb I	46 c	3573.24	Ho II
30	3565.15	Er	340	3569.49	Mn I	20 c	3573.44	Ta II
17	3565.34	Tb	6	3569.56	Pr	12	3573.52	V I
160	3565.38	Fe I	10	3569.57	Gd II	16	3573.64	Cr I
10	3565.39	Th I	5	3569.62	Th II	8	3573.70	Ce II
8	3565.65	Dy II	18	3569.67	Dy II	120	3573.72	Ir I
60	3565.74	Tb	32	3569.78	Os I	10	3573.74	Ti II
46	3565.91	Tm II	110	3569.80	Mn I	70	3573.83	Dy II
38	3566.05	Mo I		3570.04	Mn I	14	3573.85	Er
170	3566.10	Zr I	12	3569.80	Tm I	40	3573.88	Mo I
16	3566.16	Cr I	10	3569.82	Th I	10	3574.04	Cr I
15	3566.18	V I, II	20	3569.91	Er	26	3574.06	Tm II
460	3566.37	Ni I	400	3570.10	Fe I	13	3574.08	Os I
120	3566.47	Tm II	100	3570.18	Rh I	8	3574.11	U
95	3566.60	U I	24	3570.26	Re I	130	3574.18	Dy II
24	3566.72	Ta I	9	3570.41	Gd II	4	3574.20	Ho
18	3566.84	Sm II	32	3570.44	Ho	5	3574.24	Ti I
5	3567.06	Th II	3.0	3570.56	Pr	28	3574.43	La I
11 d	3567.12	Gd II	12	3570.56	Yb II	7	3574.54	Yb II
13	3567.16	Ru I	70	3570.59	Ru I	20	3574.58	Ru I
12	3567.26	Th I	16	3570.60	Er	34	3574.74	Gd II
12	3567.32	Ho	30	3570.65	Mo I	13	3574.76	U I
85	3567.35	Tb II	3.0	3570.65	U	42 h	3574.80	Cr I
30	3567.36	Hf I	30	3570.66	W I		3574.94	Cr I
40	3567.36	Tm I	90	3570.74	Er	100	3574.96	Co I
11	3567.65	Gd II	3.0	3570.93	U II	70 c	3574.80	Ho II
5	3567.69	Th II	4	3570.98	Ce II	6	3574.96	Pr II
550	3567.70	Sc II	7	3571.04	V I	6	3575.13	Nb I
280	3567.84	Lu I	500	3571.16	Pd I	20	3575.23	W I
6	3568.00	Ir I	6	3571.18	U	4	3575.29	Ce II
20	3568.04	W I	9	3571.34	Dy I	8	3575.29	Tm I
11	3568.13	Ce II	24	3571.43	Y I	38	3575.32	Th II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
160	3575.36 Co I		7	3579.67 Sm		11	3584.51 Ta I	
3.0	3575.54 Pr		7	3579.77 Ru I		420	3584.52 Y II	
170	3575.79 Zr I		17	3579.90 Hf I		13	3584.66 Fe I	
180	3575.85 Nb I		6 h	3579.95 Pr		130	3584.88 U I	
17	3575.90 Tb		40	3580.03 Dy II		550	3584.96 Gd II	
10	3575.98 W I		80 c	3580.15 Re II		60	3584.97 Nb I	
10	3576.01 Dy II		10	3580.23 Th		75	3585.03 Tb	
34	3576.05 Y I		8	3580.25 U I		9	3585.06 Th II	
4	3576.16 Nd		600	3580.27 Nb I		300	3585.08 Dy II	
10	3576.22 U		100	3580.49 Er II		65	3585.16 Co I	
19	3576.23 Ce II		14	3580.54 Mo I		16	3585.30 Cr II	
400	3576.25 Dy II		8	3580.56 Ce II		36	3585.32 Fe I	
900	3576.35 Sc II		15	3580.62 Gd II		50	3585.47 Yb II	
14	3576.56 Th II		46	3580.75 Ho II		30	3585.71 Fe I	
8	3576.60 Dy II		700	3580.94 Sc II		19 d	3585.76 Th II	
17	3576.64 Tb		32	3580.94 Sm II			3585.89 Th II	
10	3576.77 Gd II		65	3580.97 Re I		130	3585.77 Dy II	
24	3576.83 Tb		600	3581.20 Fe I		14	3585.83 Sm	
200	3576.85 Zr II		46	3581.83 Ho II		10	3585.84 U	
150	3576.89 Dy II		15	3581.84 U		26	3586.07 Tm I	
24	3577.08 Tb		170	3581.89 Mo I		50	3586.11 Dy II	
6	3577.08 U		100	3581.91 Gd II		13	3586.11 Fe I	
95	3577.46 Ce II		17	3582.01 Dy II		20	3586.29 Ta I	
9 d	3577.47 Pr I		14	3582.01 Th		140	3586.29 Zr I	
28	3577.55 Zr I		12	3582.02 U		7	3586.51 Os I	
24	3577.72 Nb I		6 h	3582.25 Pr		110	3586.54 Mn I	
22	3577.79 Sm II		10	3582.36 Nb I		9	3586.58 Gd II	
7	3577.87 V I		8	3582.62 U		36	3586.64 Er	
220	3577.88 Mn I		11	3582.63 Nd		8	3586.75 Ce II	
15	3577.92 U I		7	3582.67 Sm II		5	3586.82 Nd	
75	3577.98 Dy II		9 c	3582.80 Ho		8	3586.86 Mo I	
3	3578.08 Co I		7	3582.81 V I		40	3586.99 Fe I	
24	3578.23 Zr II		6	3582.88 Nd		5	3587.13 Ti II	
30	3578.31 Er		80	3583.02 Re I		420	3587.19 Co I	
10	3578.33 U II		10 d	3583.04 Th II		15	3587.19 Gd II	
40	3578.36 Gd II			3583.11 Th I		40	3587.20 Ru I	
2400	3578.69 Cr I		400	3583.10 Rh I		4	3587.22 Ce II	
12	3578.70 Tb		12	3583.28 Hf I		13	3587.32 Os I	
26	3578.72 U		26	3583.39 Sm II		60	3587.44 Tb II	
3 d	3578.90 Co I		8	3583.43 Tm I		11	3587.46 Sm II	
	3579.03 Co I		10	3583.53 Rh I		28	3587.51 Nd II	
3.0 h	3579.09 Pr		10	3583.65 Gd I		18	3587.64 Ce II	
14	3579.12 Dy II		8	3583.66 Ce II		38	3587.75 Y I	
90	3579.12 Ho I		8	3584.18 Th I		12	3587.76 Tb	
36	3579.12 Re I		14	3584.21 Ta I		20	3587.77 Er II	
120	3579.20 Tb II		24	3584.26 Pr II		5 d	3587.78 U I	
24	3579.35 Th II		14	3584.26 Sm II			3587.84 U	
8	3579.42 Dy II		20 h	3584.33 Cr I		5 d	3587.87 Pr	
19	3579.44 Er		10	3584.34 Ce II		12	3587.93 Ni I	
10	3579.55 Gd II		36	3584.43 Dy II		70	3587.98 Zr II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
8	3588.13 Ce II		50	3591.81 Dy II		40	3595.83 Er I	
8	3588.21 Gd I		13	3591.91 Gd II		7	3595.91 Nd	
12	3588.22 Th II		8	3592.02 Mo I		20	3596.05 Ti II	
7	3588.23 Nd		65	3592.02 V II		36	3596.06 Dy II	
28	3588.32 Zr II		5	3592.09 Nd II		38 c	3596.11 Bi I	
20	3588.35 Er		50	3592.12 Dy II		10	3596.12 Ce II	
19	3588.43 Ce II		70 c	3592.23 Ho II		650	3596.18 Ru I	
3.0	3588.60 Pr		7	3592.32 Os I		9	3596.19 Pr II	
13	3588.95 Mo I		10	3592.42 W II		400	3596.19 Rh I	
7	3589.11 Fe I		75	3592.53 V I		20	3596.34 Lu I	
90	3589.11 Nb I		18	3592.59 Nd II		85	3596.38 Tb II	
8	3589.15 Th II		350	3592.60 Sm II		16	3596.39 Re I	
650	3589.22 Ru I		110	3592.71 Gd II		9	3596.49 Dy II	
8	3589.27 Eu I		19	3592.78 Th I		4	3596.73 Ce II	
60	3589.36 Nb I		360	3592.92 Y I		6 d	3596.76 U	
14	3589.36 Th II		5	3592.97 U I			3596.88 U	
6	3589.47 Pr		700	3593.02 Ru I		11	3596.84 Gd I	
7	3589.50 Sm		3.0 h	3593.04 Pr		500	3597.15 Rh I	
12	3589.53 Tb		19 c	3593.07 Ho II		6	3597.26 Nb I	
360	3589.64 Sc II		24 cw	3593.10 Tb		20	3597.29 Dy I	
10	3589.66 U I		7 h	3593.13 Zr I		24	3597.42 Hf II	
13	3589.69 Y I		9	3593.15 Dy II			3597.51 Hf I	
12	3589.75 Th I		10	3593.20 U I		120	3597.70 Ni I	
75	3589.76 V II		36	3593.33 V II		10	3597.95 Dy II	
28 cw	3589.77 Ho		20	3593.44 Gd II		20	3598.02 Nd II	
10	3589.79 U II		2100	3593.49 Cr I		46	3598.06 Tb II	
32	3590.05 Dy II		19	3593.52 U		65	3598.11 Os I	
12	3590.32 U II		5	3593.68 U		19	3598.12 Th I	
55	3590.47 Gd II		7	3593.73 Sm II		14	3598.20 Ce II	
360	3590.48 Sc II		12	3593.75 Tb		10	3598.27 Dy II	
13	3590.50 U II		10	3593.88 Th II		6	3598.35 Nb I	
30	3590.60 Ce II		60	3593.97 Nb I		16	3598.62 Tm I	
26	3590.67 Dy II		32	3594.39 Ir I		16	3598.72 Ti I	
60	3590.73 Er I		20	3594.57 Dy		120 cw	3598.77 Ho II	
12	3590.73 Tm I		6	3594.61 Ce II		8	3598.77 Re I	
25	3590.74 Mo I		8	3594.64 Fe I		26	3598.88 Mo I	
10	3590.83 W I		8	3594.65 Tb		10	3599.06 Dy II	
7	3590.88 Re I		120	3594.87 Co I		3.5	3599.13 Cu I	
8	3591.06 Th II		12	3594.95 U		8	3599.16 Tm II	
17	3591.23 Ho II		12	3594.98 Tb II		18	3599.28 Nb I	
5	3591.31 Eu II		160	3595.05 Dy II		9	3599.48 Dy II	
6	3591.39 Tb		44	3595.12 Mn I		38	3599.48 Ho I	
100	3591.43 Dy II		8	3595.16 Re I		60	3599.51 Er II	
9	3591.44 Gd II		14	3595.30 Dy II		18	3599.63 Nb I	
10	3591.46 Th I		5	3595.33 Th II		130	3599.76 Ru I	
6	3591.56 U		7	3595.41 Nd		100	3599.84 Er II	
12	3591.66 Tb II		13	3595.55 Mo I		6	3599.84 U	
11	3591.72 Zr I		5	3595.61 Th I		60	3599.87 Hf I	
7	3591.74 Sm II		20	3595.64 Ta I		14	3599.90 Zr II	
16	3591.74 U I		8	3595.71 Mo I		8	3599.97 Ce II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
20	3600.04	Tb	8	3604.68	Th I	200	3608.77	Tm II
4	3600.12	Nd	20	3604.72	Er II	200	3608.86	Fe I
12	3600.28	Mo I	110	3604.87	Gd I	6	3608.96	U
6	3600.29	U	50	3604.89	Er II	7	3609.15	Os
16	3600.34	Dy II	34	3604.90	Tb II	14	3609.22	Th II
50	3600.39	Dy II	11	3605.05	Pr II	10	3609.25	Dy II
170	3600.44	Tb II	5	3605.20	Th I	70	3609.44	Th II
15	3600.54	Ce II	28	3605.26	Gd II	5	3609.48	Cr I
1300	3600.73	Y II	19	3605.28	U	280	3609.49	Sm II
9	3600.75	Pr	1600	3605.33	Cr I	24	3609.54	Tm II
18	3600.91	Nd II	50	3605.36	Co I	2200	3609.55	Pd I
60 c	3600.95	Ho II	24	3605.46	Fe I	10	3609.68	U
55	3600.96	Gd II	5	3605.48	U II	50	3609.69	Ce II
28	3601.04	Th II	6	3605.59	V I	22	3609.77	Ir I
9	3601.06	La II	13	3605.64	Ru I	19	3609.79	Nd II
3.0	3601.19	U	8	3605.65	Th II	17 d	3610.04	Th II
550	3601.19	Zr I	26	3605.66	Gd II		3610.13	Th II
44	3601.67	Cr I	16	3605.69	Er I	5	3610.05	Cr I
28	3601.69	Sm II	14	3605.77	Ho I	20	3610.16	Fe I
12	3601.75	Tb II	26	3605.86	Rh I	50	3610.16	Ti I
20	3601.83	Os I	6	3605.96	Pr	5	3610.24	Yb II
800	3601.92	Y II	30	3606.04	Tb II	6	3610.25	La II
10	3602.00	Gd II	30	3606.07	W I	55	3610.30	Mn I
3.5	3602.03	Cu I	160	3606.13	Dy II	12	3610.40	Th II
100	3602.08	Co I	30	3606.16	Tb II	120	3610.46	Ni I
7	3602.48	Ta I	4	3606.30	Nd	16	3610.49	Re I
6	3602.48	U I	15	3606.32	U II	6	3610.49	U
60	3602.56	Nb I	9	3606.35	Dy II	360	3610.51	Cd I
5	3602.57	Cr I	13	3606.48	Yb II	6	3610.69	U
14 c	3602.65	Ho II	32	3606.68	Fe I	85	3610.76	Gd II
32	3602.82	Dy II	15	3606.69	V I	14	3610.79	Th II
34	3602.94	Mo I	12	3606.90	Dy II	11	3610.91	Ce II
13	3603.15	Dy II	10	3607.07	W I	22	3610.91	Gd II
16	3603.20	Eu II	13	3607.12	Gd II	1000	3611.05	Y II
16	3603.21	Fe I	20	3607.21	Er I	10	3611.15	Dy I
24	3603.21	Th II	12	3607.35	Tm II	3.0	3611.24	U
6	3603.36	Ce II	26	3607.38	Zr II	7	3611.30	Yb II
5	3603.36	Th II	100	3607.41	Ta I	34	3611.33	Tb II
6	3603.36	U I	40	3607.45	Er I	11	3611.34	Ce II
11	3603.74	Cr I	65	3607.54	Mn I	3.0	3611.40	U I
	3603.78	Cr II	36	3607.63	Ce II	28	3611.41	Tb II
5	3603.74	U I	7	3607.72	Nd	8	3611.57	Eu II
5	3604.05	Th II	3.0 h	3607.82	Pr	6	3611.61	Tm II
8	3604.07	Mo I	6	3608.25	Tb II	4 h	3611.65	Ce II
6	3604.08	Nb I	26	3608.37	Mo I	11	3611.70	Co I
14	3604.20	Ce II	12	3608.38	Th I	110	3611.89	Zr II
140	3604.28	Sm II	5	3608.40	Cr I	15	3611.94	Pr II
8	3604.36	Dy II	65	3608.49	Mn I	17	3612.00	Mo I
8	3604.39	Re I	10	3608.73	Ru I	8	3612.32	Ce II
10	3604.48	Os II	85	3608.75	Gd II	9	3612.34	La II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
8	3612.39 Tm II		6	3615.54 U		200	3618.77 Fe I	
9	3612.43 Sm II		5	3615.63 Ce II		11	3618.90 Nb I	
14	3612.43 Th I		11	3615.64 Cr I		12	3618.90 Tb II	
13	3612.45 Mo I		34 d	3615.66 Tb II		50	3618.92 Er II	
260	3612.47 Rh I		8	3615.74 Mo I		18	3618.96 Nd II	
9	3612.61 Cr I		22	3615.82 Nd II		3.0	3619.10 Pr	
8	3612.67 U II		12	3616.06 Dy II		3.0	3619.13 U II	
3.0	3612.72 Pr		5	3616.15 Eu II		10	3619.20 Ru I	
48	3612.74 Ni I		11	3616.20 Ce II		44	3619.28 Mn I	
5	3612.75 Nd		13	3616.33 U I		600	3619.39 Ni I	
26	3612.77 Dy II		10	3616.35 Dy II		22	3619.41 Ho II	
5	3612.87 Th I		26	3616.57 Os I		13	3619.43 Os I	
70	3612.88 Cd I		300	3616.58 Er II		14	3619.47 Dy II	
8	3612.88 Gd II		34	3616.58 Tb II		36	3619.51 Nb II	
7	3613.03 Tm II		9	3616.68 Pr II		3	3619.71 Th II	
20	3613.06 Dy II		7	3616.72 V I		6	3619.73 Nb II	
17	3613.06 Tb II		13	3616.76 U II		40	3619.73 Tb II	
9	3613.08 La I		9	3616.84 Mo I		20	3619.82 Yb II	
180	3613.10 Zr II		3.0	3616.89 U		6	3619.92 Ce II	
38	3613.31 Ho II		90	3616.89 Hf I		18	3619.96 Dy II	
10	3613.36 Tb II		12 c	3616.93 Ho II		15	3619.97 Tm II	
17	3613.37 M I		6	3616.95 Ru I		10	3620.04 Hf I	
55	3613.39 Gd II		48 d	3617.02 Th II		13	3620.08 U I	
14	3613.58 Sm II			3617.12 Th II		14	3620.10 Sm II	
13	3613.64 Mo I		32	3617.08 Re I		50	3620.18 Dy II	
24	3613.68 Tb II		44	3617.16 Gd II		6	3620.28 Ru I	
38	3613.70 Ce II		19	3617.21 Ir I		14	3620.37 Th II	
22	3613.70 Zr I		12	3617.24 Dy II		2.5	3620.43 Co I	
10	3613.78 Th II		8	3617.25 Re I		40	3620.46 Gd II	
10	3613.79 W II		10	3617.43 Sc		17	3620.46 Rh I	
2500	3613.84 Sc II		3.0	3617.49 U		9	3620.56 Dy II	
10	3614.01 Th II		240	3617.52 W I		20	3620.58 Sm II	
26	3614.08 Dy II		3.0	3617.62 U		550	3620.94 Y I	
28 d	3614.21 Gd II		10	3617.65 Dy II		24	3621.03 Nb I	
	3614.42 Gd I		12	3617.68 Hf I		6	3621.09 Pr II	
5	3614.21 Th I		11	3617.71 Nb I		19	3621.12 Th II	
5	3614.35 Th I		9	3617.74 Dy II		4	3621.15 Ce II	
7	3614.45 Cd I		13	3617.79 Fe I		140	3621.23 Sm II	
34	3614.63 Tb II		50	3617.82 Er II		24	3621.46 Fe I	
9	3614.70 Dy		40	3617.88 Tb II		16	3621.46 Re I	
180	3614.77 Zr II		26	3618.08 Dy II		16	3622.00 Fe I	
20	3614.78 Rh I		8	3618.08 Ho II		3.0	3622.04 U	
9	3614.94 Dy		3.0	3618.08 Pr		14	3622.11 Tb II	
12	3615.04 Hf I		17	3618.18 Tb II		40	3622.15 Ce II	
34	3615.13 Th II		8	3618.36 Th I		10	3622.33 Th I	
8	3615.15 Mo I		46	3618.43 Ho I		20	3622.34 W I	
6	3615.16 Pr II		6	3618.44 Nb I		8 h	3622.38 Pr II	
11	3615.24 Sm II		40	3618.45 Dy II		6	3622.44 Ce II	
4	3615.39 Co I		6	3618.49 U		14	3622.50 Sm II	
18	3615.50 Nb I		15	3618.58 Ce II		10	3622.54 Eu II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
13	3622.70 U		60	3626.50 Tb II		13	3630.88 Gd II	
3.0 h	3622.74 Pr		150	3626.59 Rh I		22	3630.91 Ho I	
8	3622.80 Th I		130	3626.62 Ta I		20	3630.97 Pr II	
19	3622.81 Gd II		48 c	3626.69 Ho II		18	3631.02 Nd II	
16	3623.06 U II		36	3626.74 Ru I		70	3631.13 Sm II	
8	3623.19 Fe I		17	3626.87 Tb II		18	3631.19 Ce II	
25	3623.23 Mo I		70	3627.01 Sm II		8	3631.39 Co I	
20	3623.32 Sm II		16	3627.24 W I		200	3631.46 Fe I	
2.5	3623.42 Tm II		55	3627.25 Ho II		12	3631.46 Tb II	
22	3623.59 Ho I		4	3627.29 Ru I		17	3631.71 Ru I	
6	3623.64 Ru I		7	3627.41 Nd		48 c	3631.76 Ho II	
34	3623.79 Mn I		8	3627.80 Rh I		14	3631.79 Er I	
80 d	3623.84 Ce II		55	3627.81 Co I		40	3631.95 W I	
180	3623.86 Zr I		14	3627.97 Sm II		8	3632.04 Fe I	
30	3623.92 Tb II		70	3628.04 Er I		44	3632.07 Er II	
65	3623.99 Lu II		12	3628.11 Pt I		14	3632.11 Ce II	
12	3624.00 Hf II		30 d	3628.20 Tb II		10	3632.18 Eu II	
5	3624.11 Ca I		8	3628.25 Ce II		8	3632.62 Th II	
12	3624.18 Ce II		8	3628.35 Mo I		40	3632.79 Dy II	
7	3624.20 Tm I		3.0	3628.38 U		10	3632.79 Er II	
42	3624.25 Dy II		4	3628.62 Ce I		10	3632.83 Th I	
2.0	3624.33 Co I		13	3628.66 Mo I		7	3632.84 Co I	
170	3624.46 Mo I		65	3628.67 Ir I		17	3632.84 Cr I	
11	3624.65 Nd II		240	3628.71 Y II		12	3632.95 Ho II	
12	3624.73 Ni I		38	3628.83 La II		3.0	3632.95 U	
12	3624.80 Tb II		6	3629.20 Re I		12	3633.00 Nb I	
16	3624.82 Ti II		3.0	3629.31 Mo I		20	3633.03 Dy II	
28	3624.89 Gd II		30	3629.39 Er I		1000	3633.12 Y II	
19	3624.90 Th II		100	3629.43 Dy II		26	3633.26 Er I	
4	3624.96 Co I		40	3629.43 Tb II		70	3633.29 Tb II	
5	3625.15 Fe I		26	3629.51 Gd II		8	3633.29 U	
17	3625.17 Nb I		5	3629.59 Nd		11	3633.31 Nb II	
34	3625.20 Ru I		22	3629.74 Mn I		4	3633.40 Ce II	
7	3625.24 Ta I		10	3629.94 Nd II		4	3633.47 Nd	
17	3625.26 Gd II		7	3629.95 Os I		22	3633.49 Zr II	
10	3625.28 Er II		28	3630.02 Zr II		100	3633.56 Er II	
19 c	3625.46 Ho II		20	3630.08 Er II		18	3633.71 Nb I	
85	3625.54 Tb II		360	3630.25 Dy II		10	3633.77 Dy II	
28	3625.63 Th II		9	3630.25 Gd II		7	3633.79 Ta I	
8	3625.71 Ir I		30	3630.28 Tb II		8	3633.92 Ru I	
17	3625.71 Nb I		14	3630.30 Er II		8	3634.15 Dy II	
14	3625.89 Th II		5	3630.42 Ce II		50	3634.15 Zr I	
	3625.93 Th II		20	3630.47 Dy II		280	3634.29 Sm II	
16	3625.91 Re I		18	3630.62 Nb I		20	3634.30 Nd II	
5	3625.98 U		10	3630.64 Dy II		10	3634.32 Dy II	
42	3626.18 Mo I		14	3630.67 Sm II		12	3634.44 Nb I	
7	3626.18 Nd		19	3630.73 U		3.0	3634.47 Pr	
16	3626.29 Ir I		10	3630.75 Ca I		11	3634.54 Yb II	
17 d	3626.32 Gd II		1800	3630.75 Sc II		5	3634.56 U	
	3626.41 Gd II		36	3630.87 Hf II		17	3634.58 Th I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
50	3634.67 Er I		24	3637.76 Yb II		12	3640.99 Mo I	
14 c	3634.67 Ho II		11	3637.79 Nd II		24	3641.25 Ho I	
2200	3634.70 Pd I		18	3637.83 Nb I		24	3641.26 Er II	
8	3634.71 Co I		10	3637.83 Sb I		16	3641.33 Ti II	
34	3634.76 Gd II		80	3637.84 Re I		34	3641.39 Gd II	
10	3634.87 Nd II		10	3637.97 Ti I		30	3641.41 W II	
300	3634.93 Ru I		4	3638.02 Ru I		9	3641.47 Cr I	
20	3634.93 Sm II		20	3638.20 Mo I		11	3641.50 Nd II	
4	3635.11 Nd		48	3638.20 U I		20 d	3641.53 La I	
3.5	3635.14 Mo II		12	3638.28 Ce II			3641.66 La II	
8	3635.20 Ti I		13	3638.30 Fe I		11	3641.62 Pr II	
10	3635.24 Th II		48 c	3638.30 Ho II		70	3641.66 Tb II	
36	3635.26 Dy II		4	3638.32 Th		7	3641.79 Co I	
11	3635.28 Pr II		32	3638.41 Tm I		28	3641.83 Cr I	
6	3635.30 U I		70	3638.46 Tb II		6	3641.89 Er II	
12	3635.32 Nb I		3.0	3638.58 Pr		60	3642.06 Ta I	
9 c	3635.35 Ho II		5	3638.64 Th I		9	3642.20 Mo I	
6	3635.40 U II		7	3638.65 U		22	3642.25 Th I	
20	3635.42 Tb II		140	3638.69 Er I		9 c	3642.36 Ho II	
14	3635.42 Th II		4	3638.70 Nd		9	3642.44 U	
11	3635.43 Hf I		5	3638.72 Zr I		4	3642.46 Nd	
130	3635.43 Mo I		34	3638.77 Sm II		30	3642.68 Tb II	
400	3635.46 Ti I		12	3638.79 Nb I		550	3642.68 Ti I	
12	3635.52 Ru I		7	3638.79 Pt I		14	3642.76 Sm II	
19	3635.94 Th I		17	3638.95 Tb I		1200	3642.79 Sc II	
10	3636.06 Sm II		15	3639.02 V I		5	3642.83 Ce	
22	3636.20 Ir I		22	3639.05 Gd II		7	3642.94 Tm I	
16	3636.22 Dy II		24	3639.33 Nb I		3.5	3642.99 Re I	
55	3636.25 Lu I		11	3639.44 Co I		7	3643.17 Pt I	
20	3636.30 Er I		24	3639.45 Th II		8	3643.18 Co I	
28	3636.45 Zr II		26	3639.51 Rh I		8	3643.26 Tb II	
44	3636.59 Cr I		550	3639.58 Pb I		8	3643.32 Pr II	
4	3636.67 La I		80	3639.80 Cr I		10	3643.34 Nb I	
4	3636.72 Co I		30	3639.82 Tb II		8	3643.51 Th I	
12	3636.96 Nb I		20	3639.86 Dy II		11	3643.63 Nd II	
14	3637.00 Nd II		3.0	3639.89 Tm II		80	3643.66 Tm II	
14	3637.06 Re I		14 c	3640.17 Ho II		10	3643.72 Nb I	
14	3637.15 La II		26	3640.18 Gd II		8	3643.76 Tb II	
24	3637.16 Er II		100	3640.24 Dy II		7	3643.86 V I	
14	3637.23 Nd II		14	3640.24 Nd II		36	3643.89 Dy II	
32	3637.27 Dy II		44	3640.33 Os I		10	3644.13 Tb II	
20	3637.47 Ru I		11	3640.39 Cr I		24	3644.24 U I	
7	3637.51 U		22	3640.39 Fe I		4	3644.29 Ce II	
8	3637.52 Mo I		17	3640.62 Mo I		5	3644.35 Th II	
12	3637.54 Nb I		18	3640.64 Nb I		90	3644.36 Hf II	
8	3637.57 Th II		19	3640.64 Ru I		10	3644.41 Ca I	
6	3637.59 Hf I		4	3640.69 Ce II		3.0	3644.54 Pr	
5	3637.65 Pr		18	3640.76 U		15	3644.71 V I	
8	3637.75 Ce II		8	3640.80 Dy II		3.0	3644.85 U	
6	3637.76 V I		14	3640.95 U II		12	3644.94 Nb I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
18	3645.03 U		20	3648.20 Nd II		11	3651.59 Nd	
12	3645.23 Ce II		12	3648.30 Pr II		8	3651.66 Re I	
30	3645.29 Sm II		16	3648.40 Dy II		480	3651.80 Sc II	
600	3645.31 Sc II		10	3648.42 Th II		22	3651.84 Hf I	
24	3645.38 Tb II		10	3648.48 Gd I		24	3651.86 Tb II	
25	3645.39 Sm II		11	3648.53 Cr I		44	3651.97 Re I	
1000	3645.41 Dy II		9	3648.61 Mo I		28	3652.07 U	
120	3645.42 La II		90	3648.79 Dy II		12	3652.11 Ce	
12	3645.45 Ce II		5	3648.81 Os I		26	3652.17 Th II	
12	3645.54 Pr II		12	3648.97 V I		6	3652.26 Ce II	
85	3645.62 Gd II		28	3649.00 Cr I		24	3652.26 Tb II	
4	3645.63 Nd		36	3649.10 Hf I		6	3652.32 Ru I	
30	3645.66 Pr II		22	3649.25 Th II		4	3652.38 Pr	
14	3645.78 Nd II		10	3649.35 Co I		7	3652.45 Nd	
6	3645.82 Fe I		10	3649.41 Tb II		8	3652.54 Co I	
12	3645.82 Tb II		10 d	3649.41 U		60	3652.54 Gd II	
32	3645.86 Dy II			3649.58 U		10	3652.54 Th II	
14	3645.90 Sm II		30	3649.44 Gd II		32	3652.57 Er II	
80	3645.93 Er II		14	3649.46 Nd		44	3652.86 Er II	
16	3646.11 Ru I		16	3649.51 Fe I		20	3652.97 Tb II	
6	3646.16 Cr I		11	3649.53 La I		38	3653.11 Ce II	
600	3646.19 Gd II		55	3649.53 Sm II		24	3653.15 Nd II	
15	3646.20 Ti I		10 c	3649.60 Ho II		8	3653.21 U I	
30	3646.30 Pr II		4	3649.73 Ce II		5	3653.39 Ta I	
10	3646.46 Tb II		12	3649.73 Th I		600	3653.50 Ti I	
10	3646.52 W II		50	3649.85 Nb I		50	3653.61 Tm II	
16	3646.60 Dy II		8	3650.12 Ce II		8	3653.62 Re I	
14	3646.65 Ce		280	3650.15 Hg I		60	3653.67 Ce II	
15	3646.70 Tm I		46	3650.18 La II		2.5	3653.83 Ta I	
6	3646.79 Er II		8	3650.18 Pr II		17	3653.87 Tb II	
14	3646.85 Dy I		28	3650.19 Sm II		22	3653.91 Cr I	
10	3646.90 Sc		28	3650.32 Ru I		14	3654.16 Nd	
32	3646.97 Ce II		46	3650.39 Er II		10	3654.17 Dy II	
46	3647.06 Tb II		240	3650.40 Tb II		30	3654.40 Ru I	
12	3647.23 Tm II		14	3650.42 Nd II		3.5	3654.45 Co I	
7	3647.29 Sm II		10	3650.53 Hf I		24	3654.45 Ho II	
7	3647.30 Th II		3	3650.69 Nd		22	3654.49 Os I	
	3647.38 Th II		12	3650.77 Th II		24	3654.59 Ti I	
6	3647.31 Nb I		30	3650.81 Nb I		380	3654.62 Gd II	
11	3647.65 Th II		16	3650.88 Ce		30	3654.83 Hg I	
6	3647.66 Co I		30	3650.93 Tb II		11	3654.86 Sm II	
20	3647.73 Tm II		44	3650.95 Gd II		12	3654.87 Dy II	
24	3647.75 Ce II		14	3651.00 Sm II		30	3654.87 Rh I	
60	3647.75 Tb II		10	3651.00 W I		85	3654.88 Tb II	
210	3647.77 Lu I		6	3651.04 Pr		8	3654.89 U I	
160	3647.84 Fe I		16	3651.19 Gd II		28	3654.97 Ce II	
7	3647.93 Nd		48	3651.19 Nb II		7	3655.03 Nd II	
24	3647.95 Ce II		17	3651.35 Mo I		5	3655.56 Zr II	
7	3648.13 Yb I		30	3651.47 Fe I		10	3655.60 Dy II	
8	3648.17 Th II		38	3651.53 U		9	3655.73 Yb I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
40	3655.78	Sn I	32	3660.63	Ti I	12	3663.36	W I
160	3655.85	Ce II	80	3660.64	Ce II	80	3663.37	Ru I
12	3655.98	Nb I	20	3660.75	Tb II	26	3663.59	V I
300	3656.15	Gd II	10	3660.78	Er II	140	3663.65	Zr I
7	3656.20	Th II	5	3660.81	Ru I	8	3663.70	Ce II
28	3656.22	Sm II	7	3660.88	Tm II	24	3663.70	Th II
28	3656.26	Cr I	9	3660.92	Mo I	18	3664.10	Ni I
3.0	3656.34	Er II	7	3660.97	Nd	10	3664.25	Sc II
12	3656.71	V I	14	3661.05	Hf II	9	3664.30	Mo I
5	3656.89	Ta I	32	3661.20	Zr I	32	3664.44	Er I
32	3656.90	Os I	600	3661.35	Ru I	260	3664.60	Gd II
3.0	3656.97	Co I	180	3661.36	Sm II	8	3664.60	Hf I
12	3657.11	Nb I	12	3661.62	Pr II	60	3664.61	Dy II
7	3657.27	Ta I	14	3661.62	Th II	350	3664.61	Y II
7	3657.32	U	10	3661.66	Gd II	30	3664.62	Ir I
50	3657.35	Mo I	6	3661.68	Nb I	5	3664.64	Pr
6	3657.42	Pr	8	3661.69	Ta I	100	3664.70	Nb I
7	3657.49	Ta I	30	3661.71	Ir I	5	3664.73	Ce II
10	3657.59	W II	12	3661.73	Ce II	60	3664.81	Mo I
700	3657.99	Rh I	14	3661.75	Dy II	7	3665.05	Ce II
30	3658.06	Th II	22	3661.78	Mo I	8	3665.14	V I
55	3658.10	Ti I	24	3661.86	Rh I	32	3665.18	Nd II
20	3658.19	Gd I	10	3662.03	Er II	16	3665.20	Dy II
6	3658.21	Pr	10	3662.05	Nb I	22	3665.35	Hf II
24	3658.22	Tb II	20	3662.08	La II	9	3665.60	Tb II
4	3658.26	Ce II	4	3662.13	Re I	42	3665.81	Tm II
22 c	3658.48	Ho I	12	3662.14	Zr II	6	3665.98	Cr I
10	3658.78	Ta I	15	3662.16	Co I	8	3666.02	Ce I
200	3658.88	Tb II	16	3662.24	Ti II	10 d	3666.10	U
10	3659.01	U	140	3662.26	Gd II		3666.21	U
9	3659.04	Pr	28	3662.26	Nd II	110	3666.22	Rh I
55	3659.16	U I	14	3662.27	Sm II	12	3666.31	Os I
40	3659.23	Ce II	180 c	3662.29	Ho I	6	3666.53	Nb I
12	3659.45	Tb II	9	3662.33	U	26	3666.54	Sc II
40	3659.51	Th II	8	3662.34	Ta II	10	3666.64	Cr I
8	3659.52	Fe I	5	3662.46	Pr I	80	3666.65	Ho I
12	3659.56	Er I	18	3662.69	Sm II	32	3666.72	Mo I
10	3659.59	U	6	3662.84	Cr I	34	3666.85	Dy I
24	3659.61	Nb II	16	3662.86	Er I	15	3666.91	Rh I
14	3659.62	Sm II	8	3662.88	Hg I	12	3666.94	Mo I
10	3659.76	Ti II	14	3662.90	Sm II	9	3666.98	Th I
7	3659.94	Nd II	9	3662.99	Ce II	5	3667.00	Nb I
32	3659.97	Ce II	48	3662.99	Ho I	14	3667.05	Ho II
5	3660.08	Pr	17	3662.99	Mo I	6	3667.13	U
16	3660.16	Ce II	5	3663.03	Nd	3	3667.14	Pr
70	3660.37	Nb I	44	3663.12	Tb II	8	3667.28	Ce II
18 c	3660.38	Pr II	16	3663.20	Th II	6 d	3667.66	Nb I
16	3660.40	Mn I	16	3663.21	Cr I		3667.76	Nb I
10	3660.44	Tb II	24	3663.28	Hg I	11	3667.67	Pr II
6	3660.52	Re I	17	3663.30	Mo I	10	3667.72	W I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
26	3667.74 V I		11	3670.52 Mn I		6	3674.14 Pr	
4	3667.82 Ta I		32	3670.53 Re I		24	3674.15 Ni I	
28	3667.93 Sm II		14	3670.53 U		16 c	3674.36 Ho II	
160	3667.97 Ho I		28	3670.68 Sm II		20	3674.45 Dy II	
80	3667.98 Ce II		5	3670.69 Yb II		12	3674.58 W I	
6	3667.98 U		180	3670.84 Sm II		5	3674.63 Eu II	
7	3668.00 Mo I		46	3670.89 Os I		6	3674.65 Nd	
4	3668.00 Tb II		9	3670.92 Nd I		100	3674.72 Zr II	
6	3668.03 Cr I		200	3671.20 Gd II		12	3674.76 Rh I	
90	3668.09 Tm II		18	3671.20 V I		50 c	3674.77 Ho II	
10	3668.14 Th I		48	3671.27 Zr II		30	3674.78 Nb I	
10	3668.21 Hf I		4	3671.37 Nb I		8	3674.83 Ta I	
8	3668.32 Gd II		34	3671.51 Pb I		2.5	3674.88 Pr	
20	3668.45 Zr II		7	3671.54 Th I		32	3674.98 Ir I	
8	3668.49 Mo I		7	3671.66 Nd		11 d	3674.99 U	
5	3668.49 Y II		50	3671.67 Ti I			3675.08 U II	
8	3668.50 Tb II		13	3671.69 Dy II		14	3675.08 Yb II	
14	3668.62 Nb I		5	3671.92 Pr		4	3675.12 Ta I	
10	3668.66 W I		12	3671.94 Ce II		3.0	3675.17 Nb I	
14	3668.72 Ce II		2.0	3672.02 La I		7	3675.18 Er II	
9	3668.79 Nd		20	3672.17 Ce I, II		5	3675.26 Sc II	
44	3668.83 Pr II		20	3672.27 Hf I		10	3675.36 Mo I	
13	3668.90 Dy II		85	3672.31 Dy II		12	3675.45 Os I	
32	3668.97 Ti I		32	3672.36 Nd II		20	3675.56 W I	
42	3669.01 Er II		10	3672.40 V I		50	3675.57 Th II	
24	3669.01 Nb I		8	3672.41 Re I		30	3675.70 V I	
36	3669.05 Ho II		6 hc	3672.44 Nb I		48	3675.74 Hf I	
7	3669.15 U		11	3672.58 U		22	3675.78 Tb II	
12	3669.24 Ni I		36	3672.66 Dy II		2.5	3675.98 Mo I	
24	3669.34 Mo I		8	3672.69 Ho I		10	3676.00 Dy II	
12	3669.41 V II		32	3672.79 Ce II		6	3676.00 Re I	
11	3669.45 Nd		65	3672.82 Mo I		8	3676.16 Ce II	
60	3669.49 Ru I		10	3673.06 U		10	3676.24 Mo I	
16	3669.52 Fe I		10	3673.14 Tm II		10	3676.31 Nb I	
50	3669.52 Ho I		34	3673.15 Dy II		7	3676.32 Cr I	
5	3669.52 Pr		5	3673.19 Eu II		380	3676.35 Tb II	
26	3669.62 Tb I		3.0	3673.23 Nb I		17	3676.51 Er II	
24	3669.70 Yb II		10	3673.26 Th II		14	3676.55 Co I	
11	3669.74 Nb I		11	3673.39 U		190	3676.56 Dy II	
5	3669.75 Nd		30	3673.40 V I		15	3676.56 U II	
12	3669.78 Re I		34	3673.54 Nd II		18	3676.68 V I	
20	3669.96 Th I		16	3673.64 Ce II		11	3676.96 Mn I	
	3670.06 Th II		14	3673.79 Th II		10	3677.08 Nb I	
160	3670.07 U II		8 d	3674.05 Ce II		15	3677.39 U I	
5	3670.26 Pr			3674.15 Ce		5	3677.60 Nd	
10	3670.28 Ho II		100	3674.05 Gd I		20	3677.63 Fe I	
8	3670.36 Re I		10	3674.05 Tb II		20 cw	3677.64 Ho II	
4	3670.42 Mo I		14	3674.07 Sm II		11	3677.67 U	
16	3670.43 Ni I		120	3674.09 Dy II		4	3677.68 Cr II	
8	3670.49 Ce		11 d	3674.13 U		10	3677.70 Mo I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
12	3677.78 Nb I		8	3681.57 Os I		4	3686.11 Mo I	
28	3677.79 Sm II		2.0	3681.69 Cr I		12	3686.18 Ta I	
6	3677.89 Cr II		22	3681.73 Sm II		20	3686.26 V I	
30	3677.89 Tb II		6 h	3681.86 Pr		70	3686.33 Gd II	
34	3677.98 Tm II		6	3681.88 Th II		9	3686.56 Nb I	
28	3678.04 Th II		13	3682.04 U		16 c	3686.65 Ho II	
14	3678.18 Nd II		16	3682.08 Ce II		14	3686.80 Cr I	
5	3678.26 Eu II		8	3682.09 Mn I		30	3687.04 Pr II	
22	3678.32 Ru I		80	3682.09 W I		20	3687.08 Ir I	
3.5	3678.35 Sc II		16	3682.21 Fe I		7	3687.10 Sm II	
55	3678.48 Dy I		220	3682.24 Hf I		18	3687.20 Pr II	
24	3678.59 Ho II		80	3682.26 Tb II		14	3687.25 Cr I	
3.0	3678.72 Nb I		8	3682.46 U II		26	3687.30 Nd II	
22	3678.75 U		80	3682.65 Ho I		8	3687.35 Ti I	
10	3678.78 Tb II		44	3682.71 Er II		3.0	3687.44 Nb I	
38 d	3678.86 Tm II		20	3683.05 Co I		80	3687.46 Fe I	
	3678.95 Tm II		11	3683.06 Fe I		50	3687.47 V I	
6	3678.88 Nd		7	3683.06 Ta I		8	3687.54 Cr I	
18	3678.90 Zr II		60	3683.13 V I		300	3687.74 Gd II	
17	3678.95 Er I		12	3683.20 Tm II		16	3687.80 Ce II	
8	3679.16 Ce II		50	3683.31 W I		12	3687.97 Nb II	
80	3679.19 Ho I			3683.39 W I		140	3688.07 V I	
34	3679.21 Gd I		1400	3683.48 Pb I		70	3688.07 W I	
14	3679.38 U I		13	3683.59 U		32	3688.15 Tb II	
20	3679.42 Ce II		20	3683.94 W I		9	3688.18 Nb II	
10	3679.61 W I		28	3684.01 Er I		7	3688.31 Mo II	
75	3679.70 Ho I		11	3684.11 Fe I		10	3688.36 Dy II	
20	3679.72 Th II		200	3684.13 Gd I		550	3688.42 Eu II	
16	3679.81 U		5	3684.22 Mo II		16	3688.42 Ni I	
4	3679.82 Cr I			3684.33 Mo I		22	3688.42 Sm II	
65	3679.92 Fe I		34	3684.27 Er II		2.0	3688.46 Cr I	
6	3679.99 Pr		5	3684.29 Nd		6	3688.66 Ce II	
18 c	3680.00 Ho II		5	3684.32 Lu I		12	3688.70 Nb I	
16	3680.08 Ce II		4	3684.48 Co I		17	3688.76 Th II	
6	3680.09 Er II		13	3684.62 U		8	3688.97 Mo I	
32	3680.11 V I		10	3684.66 W I		9	3689.04 Nb I	
3.5	3680.21 Re I		22	3684.81 Tb II		24	3689.06 Os I	
7	3680.37 Zr I		70	3684.83 Dy I		14	3689.12 Er II	
140	3680.60 Mo I		48	3685.16 Ho II		24	3689.12 Tb II	
	3680.68 Mo I		260	3685.20 Ti II		4	3689.16 Ce II	
4	3680.85 Ce II		3	3685.27 Pr		13	3689.46 Fe I	
14	3680.88 U		13	3685.55 Cr I		85 c	3689.50 Re I	
11	3680.98 Sm I		11	3685.78 U I		24	3689.69 Nd II	
48	3681.04 Rh I		70	3685.80 Nd II		12	3689.71 Pr II	
5	3681.04 Ta I		110	3685.81 Dy I		12	3689.72 Tb II	
5	3681.24 Ta		4	3685.95 Ru I		12	3689.73 Ta I	
3.5	3681.28 Re I		10	3685.96 Ti I		50	3689.91 Ti I	
16	3681.38 Ce II		13	3686.00 Fe I		7	3690.08 Sm I	
10 d	3681.55 Mo I		4	3686.04 Ce I		110	3690.28 V I	
	3681.72 Mo I		7	3686.07 Nd		600	3690.34 Pd I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
15	3690.49 Th II		3694.82 Tm II	120	3698.17 Zr II
5	3690.56 Yb II	14	3694.75 Tb II	85	3698.18 Dy II
26	3690.59 Mo I	400	3694.81 Dy II	2.5	3698.18 Ti I
65	3690.65 Ho I	18	3694.81 Nd II	24	3698.26 Rh I
160	3690.70 Rh I	24	3694.91 Ce II	4	3698.30 Th II
3.5	3690.72 Co I	160	3694.94 Mo I	9	3698.36 Ce II
7	3690.93 Sm II	5	3694.95 Rh I	10	3698.40 Hf II
60	3691.15 Tb II	8	3695.05 Fe I	5	3698.43 Ti I
26 c	3691.32 Ho II	48	3695.34 V I	6	3698.53 Mo I
6	3691.48 Pr	7	3695.38 Ta I	7	3698.59 Yb II
150 c	3691.48 Re I	80	3695.52 Rh I	32	3698.60 Rh I
13	3691.88 Th I	12	3695.69 Ho I	11	3698.66 Ce II
40	3691.92 U	110	3695.86 V I	3.5	3698.83 Os I
38	3691.95 Ho I	10	3695.90 Nb II	20	3699.33 Tb II
2.5	3692.08 Mo I	6	3695.96 Ce	10	3699.42 W I
22	3692.22 Sm II	11	3695.98 Th II	6	3699.51 Pr
160	3692.22 V I	10	3696.04 Mo I	24	3699.72 Hf II
800	3692.36 Rh I	5	3696.12 Ce II	130	3699.73 Gd II
20	3692.53 Y I	40	3696.25 Er II	14	3699.87 Tm II
12	3692.57 Th I	17	3696.30 Tb II	3.5	3699.91 Pt I
700	3692.64 Er II	28	3696.51 Hf I	12	3699.92 Ce II
20	3692.64 Mo II	20	3696.57 Mn I	10	3699.93 Nb I
10	3692.76 Sm II	24	3696.59 Ru I	8	3700.01 Mo I
30	3692.95 Tb II	5	3696.65 Th II	46	3700.04 Ho I
9	3693.05 Ta I	3	3696.66 Pr	5	3700.08 Ti I
12	3693.11 Co I	13	3696.76 Gd II	44	3700.12 Tb I
6	3693.36 Pr	32	3696.85 Tb II	400	3700.26 Tm II
16	3693.37 Nb I	14	3696.91 Er II	3.5	3700.37 Re I
18	3693.38 Mo I	10	3696.93 Gd I	7	3700.57 Yb I
8	3693.42 Ce II	12	3696.94 Dy II	40	3700.58 U II
12	3693.48 Co I	5	3697.03 Th II	20	3700.59 Dy II
6	3693.49 Pr	14	3697.13 U	22	3700.60 Sm II
44	3693.56 Tb I	7	3697.17 Nd	48	3700.72 Er II
32	3693.67 Mn I	9	3697.24 Er I	8	3700.77 Th II
24	3693.70 U	32	3697.31 Dy II	650	3700.91 Rh I
4	3693.71 Ce II	13	3697.39 Nb I	22	3700.92 Sm II
14	3693.84 Dy I	48	3697.46 Zr II	3.0	3700.98 Th I
20	3693.90 Th II	24	3697.56 Nd II	12	3700.99 Ru I
8	3693.93 Ni I	7	3697.57 Tm II	30	3701.09 Fe I
85	3693.99 Sm II	10	3697.66 Ce II	20	3701.14 Tb I
24	3694.01 Fe I	34	3697.68 Er I	34	3701.15 Hf II
20	3694.03 Gd II	10	3697.71 Re I	14	3701.27 Ho I
3200	3694.19 Yb II	200	3697.73 Gd II	15	3701.33 Tb I
14	3694.30 Sm II	10	3697.76 Ru I	2.5	3701.34 Ta I
12	3694.41 Dy II	160	3697.85 Nb I	320	3701.36 Tm II
12	3694.45 Ti I	16	3697.93 U	8	3701.50 Tb II
7	3694.52 Ta II	16	3698.07 Pr II	80	3701.52 U II
15	3694.66 Ho	8	3698.10 Ir I	17	3701.56 Er II
16	3694.67 Nb I	13	3698.11 Th I	8	3701.56 Sm II
34	3694.73 Tm II	5	3698.13 Ce II	46	3701.62 Dy II

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
8	3701.73 Mn I		10	3705.02 Re I		14	3708.72 V I	
6	3701.75 Nd		13	3705.04 U		18	3708.75 Tb II	
15	3701.78 Ho II		60	3705.04 V I		2.5	3708.76 Th II	
4	3701.81 La II		24	3705.06 Tb I		12	3708.82 Co I	
10	3701.81 Pr II		12	3705.40 Hf II		6	3709.13 Gd II	
24	3702.03 Mo I		6	3705.41 Mo I		12	3709.14 Os I	
15	3702.24 Co I		80	3705.57 Fe I		85	3709.25 Fe I	
2.5	3702.24 Ru I		9	3705.77 Er I		20	3709.25 Nb II	
10	3702.29 Ti I		38	3705.82 La II			3709.42 Nb I	
10	3702.32 W I		8	3705.98 U		90	3709.26 Zr II	
55 c	3702.35 Ho II		12	3706.03 Ca II		28	3709.27 Ho	
3.0	3702.50 Er II		10	3706.04 V I		85	3709.29 Ce II	
20	3702.55 Mo I, II		24	3706.08 Mn I		36	3709.30 Tb II	
17	3702.62 U I		12	3706.23 Ti II		10	3709.52 Sm II	
10	3702.79 Ce II		28	3706.34 Tb II		36	3709.76 Ho I	
14	3702.84 Nd		14	3706.52 Er I		8	3709.88 U	
460	3702.85 Tb II		1.8	3706.53 Pt I		85	3709.93 Ce II	
3.0	3702.87 Th II		12	3706.56 Os I		24	3709.93 Re I	
30	3703.07 Tb I		11	3706.63 Zr I		24	3709.96 Ti I	
13	3703.16 Nb I		36	3706.75 Sm II		36	3710.08 Dy II	
52	3703.24 Re I		24	3706.77 Pr II		6	3710.14 Mo I	
18	3703.25 Os I		24	3706.77 Th I		1500	3710.30 Y II	
17	3703.27 U I		10	3706.80 Tb I		5	3710.33 Yb II	
10	3703.36 W I		11	3706.90 Ho II		7	3710.45 Nb I	
8	3703.50 Tb II		9	3706.94 Ce II		10	3710.73 Dy II	
4	3703.51 Gd II		36	3706.98 Sm II		18 c	3710.74 Ho II	
400	3703.58 V I		3.0	3707.00 Th I		3.0	3710.76 Er II	
6	3703.78 Th I		9	3707.17 Mo I		2.0	3710.79 Ta I	
7	3703.88 Nd		8	3707.17 Sm II		5	3710.87 Eu II	
13	3703.91 Nb I		17 d	3707.29 U		12	3710.87 Sm II	
240	3703.92 Tb II			3707.39 U		5	3710.95 Lu I	
18 d	3703.92 Th II		7	3707.39 Ce II		18 c	3711.10 Pr II	
	3704.00 Th II		28	3707.42 Dy II		20	3711.30 Th II	
36	3704.06 Co I		3.0	3707.43 Th II		18	3711.31 Ho II	
17	3704.10 U		3.0	3707.47 Co I		34	3711.34 Nb I	
15	3704.14 Nb I		4	3707.53 Ti I		3.0	3711.51 Mo I	
16	3704.30 Ti I		38	3707.57 Dy II		36	3711.54 Sm II	
4	3704.32 Pr		46	3707.63 Er II		6	3711.62 Th I	
7	3704.45 Re I		8	3707.65 U		28	3711.65 Dy II	
8	3704.46 Fe I		7	3707.80 Nb I		100 d	3711.74 Tb II	
9	3704.54 Ho II		28 d	3707.82 Fe I		5	3711.78 Nb I	
14	3704.54 La I			3707.92 Fe I		9	3711.81 Er II	
190	3704.70 V I		95	3707.93 W I		18	3712.11 Sm II	
6	3704.84 Re I		8	3707.95 U I		2.5	3712.18 Co I	
28	3704.85 Tm II		38	3708.20 Dy II		10	3712.30 Ru I	
6 d	3704.87 Th I		10	3708.36 Dy II		6	3712.35 Pr	
	3704.97 Th II		36	3708.41 Sm II		46	3712.39 Er II	
10	3704.92 Hf I		10	3708.45 Tb I		4	3712.54 Th II	
14	3704.95 Nd		9	3708.56 Mo I		260	3712.70 Gd II	
18	3704.98 Ce II		70	3708.65 Sm II		26	3712.76 Sm II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
12	3712.81 Nd		6	3715.62 Pr I		34	3718.38 Ce II	
8	3712.84 Os I		24	3715.65 Mo I		18	3718.44 Tb II	
48	3712.88 Ho I		28	3715.68 Nd II		6	3718.48 Mo I	
8	3712.95 Cr II		10	3715.92 Gd I		24	3718.54 Nd	
9	3712.95 Mo I		11	3715.96 Er I		12	3718.61 U	
340	3713.01 Nb I		15	3716.07 Mo I		30	3718.62 Ho I	
80	3713.02 Rh I		14	3716.08 Tb II		8	3718.84 Zr II	
6	3713.28 Pr		7	3716.08 W II		70	3718.88 Sm II	
5	3713.43 Rh I		8	3716.14 U		150	3718.91 Pd I	
8	3713.45 Eu II		10	3716.18 Ru I		5	3718.91 V I	
9	3713.47 Mo I		10	3716.20 Pr		15	3718.93 Mn I	
65	3713.54 La II		9	3716.21 Nb I		3.5	3719.16 Eu I	
26 d	3713.56 U I		140	3716.36 Gd II		5	3719.21 Nd	
	3713.65 U		110	3716.37 Ce II		65	3719.28 Hf II	
200	3713.57 Gd I		20	3716.43 Tb II		8	3719.29 U I	
28	3713.70 Nd II		6	3716.45 Fe I		28	3719.31 Er I	
22	3713.73 Os I		4	3716.53 Cr I		24	3719.33 Ru I	
20	3713.82 Nb I		5	3716.58 Nd		12	3719.40 W I	
14	3713.84 Dy II		9	3716.87 Mo I		6	3719.44 Pr	
4	3713.96 V I		9	3716.93 Ce II		42	3719.44 Th I	
4	3713.99 Ce II		14	3716.93 Dy II		180 d	3719.45 Gd II	
30	3714.06 Pr II		3.0	3716.94 Eu II			3719.53 Gd II	
24	3714.13 Zr I		50	3716.99 Nb I		30	3719.45 Tb II	
22	3714.20 Nd II			3717.06 Nb II		20	3719.52 Os I	
7	3714.24 W I		38	3717.00 Ru I		13	3719.55 Mo I	
8	3714.37 Tb II		7 h	3717.10 Sc			3719.74 Mo I	
8	3714.55 Mo I		10	3717.10 W I		6	3719.71 Tm II	
38 d	3714.73 Nd II		9	3717.26 Er II		17	3719.80 Ce II	
	3714.81 Nd II		36 c	3717.28 Re I		600	3719.94 Fe I	
17	3714.76 U II		8	3717.29 Dy I		32	3719.96 Th II	
9	3714.77 Ce		38	3717.40 Ti I		22	3720.13 Os I	
24	3714.78 Zr II		22	3717.42 U		3.0	3720.22 Pr II	
4	3714.83 Rh I		10	3717.47 Tb II		8	3720.25 Mo I	
7	3714.86 W I		6	3717.48 Ce		19	3720.31 Th II	
16	3714.87 La II		200	3717.48 Gd I		17 h	3720.39 U	
8	3714.90 Eu II		14	3717.54 Nb I		9	3720.46 Nb II	
3.5	3715.02 Re I		3.0	3717.69 Eu II		8	3720.54 Nd	
15	3715.04 Nd II		100	3717.80 Hf I		10	3720.57 Sm II	
7	3715.05 W I		3.0	3717.83 Th II		50	3720.72 Ho	
3.0	3715.14 Ce		6	3717.84 Pr		7	3721.03 Sm I	
4	3715.23 Gd II		8	3717.88 Tb I		20 c	3721.32 Ho II	
9	3715.27 Dy II		650	3717.92 Tm I		24	3721.35 Nd II	
12	3715.39 Nd II		6	3718.02 Pr		9	3721.45 Er II	
2.5	3715.40 Ti I		7	3718.10 Dy II		7	3721.52 Nb I	
10	3715.47 Ce II		26	3718.11 U		12	3721.64 Ti II	
17	3715.47 U		7	3718.12 Y I		18 c	3721.80 Ho II	
34	3715.47 V II		3.0	3718.17 Th II		55	3721.82 Th II	
32	3715.53 La II		34	3718.19 Ce II		70	3721.85 Sm II	
8	3715.54 Dy II		4	3718.24 Tb II		3.5	3721.96 Os I	
5	3715.56 Ru I		8	3718.34 Os I		5	3722.00 V I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
24	3722.07 Gd II		11	3725.05 La II		4	3729.00 Ce II	
3.0	3722.07 Pr		75	3725.06 Tm II		6	3729.04 V I	
5	3722.10 Ce II		32	3725.16 Ti I		16	3729.10 Hf I	
24	3722.11 Th II		7	3725.22 Nb I		3.5	3729.11 Pr	
5	3722.20 V I		8	3725.32 Tb II		6	3729.22 Os I	
10	3722.25 W I		14	3725.38 Ir I		5	3729.40 Pr II	
12	3722.29 Ce II		5	3725.39 Th I		120	3729.55 Er II	
10	3722.32 Nb I		42	3725.47 Gd I, II		4	3729.68 Eu II	
13	3722.42 Nd		5	3725.49 Ru I		4	3729.74 Eu II	
12	3722.48 Ni I		20	3725.56 Mo I		16	3729.75 Sm II	
80	3722.56 Fe I		9	3725.65 U		240	3729.82 Ti I	
28	3722.57 Ti I		34	3725.68 Ce II		26	3729.82 U	
17	3722.68 U		400	3725.76 Re I		60	3729.91 Tb II	
9	3722.76 Ce II		8	3725.90 Dy I		6	3729.92 Ce II	
5	3722.79 Sb I		20 c	3725.98 Ho II		9	3730.13 U	
10	3722.95 Nb I		50	3726.10 Ru I		11	3730.33 Ce II	
13	3723.04 Tb II		15	3726.22 Mo I		9	3730.37 Th I	
5	3723.07 Ta I			3726.32 Mo I		650	3730.43 Ru I	
3.5	3723.29 Th II		280	3726.24 Nb I		10	3730.43 W I	
46	3723.50 Nd II		1.4	3726.24 Sm II		15	3730.48 Co I	
8	3723.51 Mo I		5	3726.31 Pr II		3.0	3730.56 Mo I	
4	3723.58 Pr		14	3726.49 Hf I		28	3730.58 Nd II	
3.5	3723.66 Ce II		9	3726.57 Gd I		9 c	3730.58 Pr II	
4	3723.66 Th II		1.2	3726.66 Co I		10	3730.60 Dy II	
6	3723.66 Er II		16	3726.72 Th II		8	3730.73 Os I	
6	3723.69 Gd II		14	3726.80 Sm II		4	3730.74 Sm I	
4	3723.81 Mo I		15	3726.90 Nd		12	3730.75 Th II	
4	3723.84 Tb II		3.0	3726.92 Fe I		14	3730.81 Cr I	
3.0	3724.02 Sm II		800	3726.93 Ru I		10	3730.81 Tm II	
6	3724.22 Yb II		14	3726.96 Ce II		150	3730.84 Gd II	
8	3724.23 U		14	3727.23 Nb I		8	3731.00 Tb I	
15	3724.38 Er II		26	3727.34 V II		16	3731.02 Ta I	
8	3724.38 Fe I		4	3727.38 Sm II		3.0 d	3731.17 Ce I	
140	3724.42 Dy II		75	3727.62 Fe I			3731.26 Ce I	
8	3724.45 Er II		55	3727.69 Mo I		10	3731.22 Nd II	
30	3724.45 Ho		8	3727.90 Th I		160	3731.26 Sm II	
50	3724.57 Ti I		26	3727.99 Dy I		1.6	3731.26 Th I	
12	3724.64 Ce II		40	3728.02 Ce II		34	3731.26 Zr II	
6	3724.74 Th II		1000	3728.03 Ru I		40	3731.27 Er II	
24	3724.87 Nd II		42	3728.13 Nd II		20	3731.36 Ir II	
32	3724.90 Sm II		9	3728.18 Ce II		120	3731.40 Ho I	
20	3724.92 Er II		18	3728.30 Mo I		3.0	3731.42 Th II	
13	3724.92 Tb I		5	3728.34 V II		7	3731.45 U I	
1700 cw	3724.94 Eu II		65	3728.42 Ce II		5	3731.50 Pr	
1.4	3724.94 Rh I		120	3728.47 Sm II		14	3731.51 Tb I	
16	3724.97 Ru I		16	3728.50 Mo I		17 d	3731.58 U	
26 d	3724.99 U II		7	3728.65 Tb			3731.77 U	
	3725.07 U		6	3728.89 Mn I		5	3731.63 Nd	
8	3725.03 Pr		7	3728.93 Sm II		5 d	3731.78 Er II	
8	3725.05 Ho I		12	3728.96 Tb		14	3731.87 Re I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
9	3731.88	Ce II	18	3734.70	Yb I	7	3738.31	Fe I
15	3731.93	Mn I	12 d	3734.80	Tb	28	3738.42	Nb I
6	3732.02	Nd		3735.04	Tb	4	3738.45	Tb
16	3732.03	Cr I	700	3734.87	Fe I	14	3738.53	Ir I
10	3732.03	Nb I	20	3734.99	Ho	7	3738.61	Y I
8	3732.03	Ru I	24 c	3735.01	Re I	4	3738.63	Ru I
40	3732.09	Ho I	55	3735.28	Rh I	9	3738.76	V I
4	3732.17	Er I	6	3735.31	Pr	12	3738.84	Th II
1.8	3732.20	Eu I	80	3735.31	Re I	5	3738.90	Ti I
17	3732.26	U I	60 d	3735.54	Nd II	10	3738.91	Ru I
14	3732.28	Re I		3735.60	Nd II	12	3739.04	Hf I
26	3732.32	Gd I	9	3735.62	Mo I	220	3739.12	Sm II
40	3732.39	Tb II	4	3735.67	Ti I		3739.20	Sm II
20	3732.40	Co I	6	3735.68	Er I	42	3739.19	Pr II
12	3732.40	Fe I	26	3735.76	Pr II	6	3739.23	Ni I
22	3732.45	Gd II	4	3735.85	La II	80	3739.33	Dy I
8	3732.46	Ce II	10	3735.91	Mo I	38	3739.46	Ru I
5 d	3732.56	Ce I	8	3735.93	Co I	3.5	3739.48	W I
17	3732.58	Ce II	120	3735.98	Sm II	48	3739.76	Gd I
24	3732.59	Ho I	3.0	3736.17	Mo I	280	3739.80	Nb I
26	3732.62	U	6	3736.22	W II	9	3739.81	Dy II
8	3732.65	Tb I	90	3736.35	Ho I	280	3739.95	Pb I
22	3732.67	Gd I	10	3736.44	Gd I	32	3740.02	Gd II
36 d	3732.71	Mo I	20	3736.50	Pr II	90	3740.10	Re I
	3732.80	Mo I	17	3736.76	Ta I	6	3740.13	Ce II
30	3732.76	V II	15	3736.81	Ni I	4	3740.24	V I
16	3732.78	Nd II	4	3736.84	Re I	16	3740.28	Er II
3.5	3732.98	Th I	15	3736.90	Ca II	16	3740.32	Tb
13	3733.03	Mo I	26	3737.10	Nd	14	3740.41	Re I
12 c	3733.03	Pr II	340	3737.13	Fe I	70	3740.73	Nb II
8	3733.05	Ru I	60	3737.14	Sm II		3740.84	Nb I
26	3733.07	U	17	3737.25	U	3.0	3740.76	Mo I
50	3733.08	Gd II	36	3737.27	Rh I	8	3740.87	Th II
7	3733.32	Nb I	6	3737.39	Zr I	6	3741.01	Ce II
70	3733.32	Fe I	26	3737.40	Ru I	15	3741.01	Pr II
9	3733.40	Mo I	24	3737.48	Sm II	280	3741.06	Ti I
10	3733.49	Co I	7	3737.51	Th I	30	3741.09	Er II
12	3733.52	Ce II	9	3737.52	Ce II	90	3741.19	Th II
17	3733.58	U	20	3737.65	Ho II	20	3741.24	Tb
7	3733.62	Nb I	13	3737.74	Ce II	60	3741.29	Sm II
3.5	3733.66	Th I	5	3737.74	Ru I	30	3741.31	Eu II
46	3733.79	Hf I	16	3737.88	Hf II	16	3741.42	Nd II
200	3734.12	Tm II	20	3737.91	Mo I	10	3741.50	V I
5	3734.14	Co I	5	3737.99	V I	20	3741.58	Tb II
9	3734.37	Mo I	44	3738.05	U II	28	3741.64	Ti II
22 c	3734.41	Pr II	60	3738.06	Nd II	14	3741.71	W I
16	3734.43	V I	4	3738.08	Eu II	6	3741.73	Ce II
17	3734.46	Er II	6	3738.11	Zr II	28	3741.78	Nb I
24	3734.59	Er II	48	3738.18	Er II	24	3741.89	Tb
7	3734.59	Th II	14	3738.27	Sm II	9	3741.91	Gd II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
3.0 h	3742.22 Ce I		12	3745.50 Co I		36	3749.00 Cr I	
13	3742.26 Re II		240	3745.56 Fe I		9	3749.10 Nd	
26	3742.28 Mo I		260	3745.59 Ru I		400	3749.49 Fe I	
320	3742.28 Ru I		3.5	3745.66 Th I		8	3749.66 W	
14	3742.35 U		5	3745.72 Er II		12	3749.70 Tb	
180	3742.39 Nb I		24	3745.80 V II		12	3749.85 Nd II	
22	3742.40 Ho I		60	3745.90 Fe I		6	3749.89 Y I	
16 d	3742.43 Tb		24	3745.98 Th II		6	3749.94 Co I	
7	3742.59 Nd		70	3745.98 Zr II		14	3750.08 Ce II	
80	3742.65 Er II		7	3746.30 Tb		8	3750.13 Pr	
9	3742.68 W I		16	3746.36 Ta I		10	3750.19 Ho II	
80	3742.78 Ru I		5	3746.37 Ce II		7 d	3750.24 Tb	
11	3742.92 Th I		14	3746.40 Ce I		19	3750.31 Nd	
10	3742.97 Cr I		50	3746.41 U II		11	3750.33 Dy II	
40	3743.09 Tb		4	3746.44 Gd II		4	3750.40 Ir I	
60	3743.36 Fe I		17	3746.47 Os I		8	3750.49 Pr	
440	3743.47 Gd II		20	3746.54 Tb		17	3750.53 Er II	
3.0	3743.51 Th II		40	3746.80 Hf I		7	3750.63 Nb I	
9	3743.56 Eu II		14	3746.91 Nb I		10	3750.64 Zr II	
50	3743.58 Cr I		26	3747.12 U		6	3750.66 Sm II	
16	3743.65 Tb I		80	3747.17 Tb II		6	3750.74 Nd	
6	3743.81 Mo I		12	3747.19 Mo I		22	3750.87 V II	
90	3743.87 Sm II		55	3747.20 Ir I		12	3751.00 Ce II	
60	3743.88 Cr I		3.5	3747.27 Pr		20	3751.00 Pr II	
6	3743.99 Hf I		80	3747.34 Tb II		3.0	3751.02 Th I	
12	3743.99 Pr II		4	3747.47 Pr			3751.12 Th I	
8 d	3744.00 Ce I		8	3747.49 Hf II		10	3751.10 Gd I	
	3744.05 Ce II		80	3747.53 Er I		44	3751.18 U I	
20	3744.00 Nb I		22	3747.54 Th II		14	3751.20 Mo I	
420	3744.07 Tm I		140	3747.55 Y II		4	3751.35 Tb	
3.0	3744.10 Mo I		36	3747.62 Sm II		4	3751.43 W I	
4	3744.14 Gd I		100	3747.82 Dy II		20	3751.45 Ce II	
36	3744.17 Rh I		4	3747.98 V I		12	3751.57 Sm II	
26	3744.22 Ru I		26	3748.06 Ce II		5 c	3751.60 Pr	
8	3744.24 Nd		13	3748.10 Ti I		110	3751.60 Zr II	
22	3744.24 U		360 cw	3748.17 Ho II		4	3751.62 Tb	
9	3744.37 Mo II		100	3748.22 Rh I		2.5	3751.63 Co I	
38	3744.40 Ru I		140	3748.26 Fe I		18	3751.72 U	
9	3744.49 Cr I		16	3748.49 Mo I		3.0	3751.76 Ce II	
4	3744.74 Th II		3.0	3748.50 Pr		4	3751.78 V I	
60	3744.83 Gd I		12 d	3748.52 Sm I		14	3751.80 Dy II	
3.0	3744.94 Mo I			3748.63 Sm II		140	3751.81 Tm I	
10	3744.98 Hf II		18	3748.55 Nb I		3.0	3751.97 Er II	
18	3744.99 Er II		6	3748.61 Cr I		11 c	3752.07 Ho II	
60	3745.07 Tb I		70	3748.68 U II		7	3752.29 Nd I	
12	3745.11 Er II		12 c	3748.78 Ho II		6	3752.29 Pr	
30 cw	3745.44 Re I		8	3748.80 Tb II		11	3752.34 Ce II	
70	3745.46 Sm I		6	3748.82 Pr		34	3752.49 Nd II	
	3745.60 Sm II		12	3748.88 Gd II		360	3752.52 Os I	
10	3745.48 Mo I		5	3748.99 Er I		46	3752.57 Th II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
26	3752.66 U		4	3755.70 V I		26	3759.23 U	
22	3752.67 Nd II		14	3755.72 Ce II		280	3759.30 Ti II	
440	3752.86 Ti I		22	3755.77 Nb I		9	3759.31 Th	
8	3752.99 Tb		3.5	3755.84 Mo I		4	3759.32 V I	
15 c	3753.01 Ho II		80	3755.93 Ru I		60	3759.35 Tb I	
1.6	3753.09 Sm II		48	3756.05 Er I		14	3759.55 Nb I	
26	3753.18 Nb I		3.5	3756.29 Th I		3.5	3759.60 Mo I	
14	3753.22 Hf I		3.0	3756.35 Er II		14	3759.61 Pr II	
2.5	3753.24 Th I		60	3756.41 Sm I, II		5	3759.75 Ta I	
4	3753.27 V I		22	3756.53 Sm II		18	3759.79 Nd II	
4	3753.32 Ir I		18	3756.66 U		110	3759.84 Ru I	
6	3753.38 Pr		9	3756.70 Lu I		9	3759.88 U	
120	3753.50 Dy II		9	3756.79 Lu I		10	3759.98 Gd I	
8	3753.52 Tb		5	3756.81 Pr		34	3760.03 Ru I	
70	3753.54 Ru I		6	3756.83 Nd		26	3760.04 Sm II	
7	3753.61 Fe I		26	3756.86 Tm II		6	3760.05 Fe I	
50	3753.64 Ti I		18	3756.92 U		12	3760.08 Pr II	
36 c	3753.73 Ho II		4	3757.04 Tb		19 d	3760.13 Tb	
120	3753.76 Dy II		100	3757.05 Dy I		80	3760.13 W I	
6	3753.77 Ce II		4	3757.09 W I		2.5	3760.21 Ta I	
4	3754.03 Th I		10	3757.12 Os I		3.5	3760.28 Th II	
20	3754.12 Rh I		5	3757.17 Cr I		1.4	3760.39 Co I	
32	3754.27 Rh I		13	3757.22 Ce II		4	3760.40 Ce II	
14	3754.31 U		30 c	3757.26 Ho II		85	3760.40 Rh I	
2.0	3754.35 Co I		400	3757.37 Dy II		10	3760.47 Gd I	
5	3754.41 Pr		40	3757.44 Tb II		10	3760.48 Ho I	
18	3754.45 Ho I		90	3757.53 Sm II		1.6	3760.53 Fe I	
13	3754.52 Ta I		24	3757.66 Cr I		4	3760.64 Nb I	
9	3754.59 Th II		12	3757.69 Ti II		6	3760.69 Ce II	
8	3754.77 Dy II		10	3757.70 Th I		140	3760.69 Sm II	
6	3754.79 Zr I		22	3757.74 Gd II		60	3760.71 Gd II	
15	3754.83 Nd		2.5	3757.75 Ta I		10	3760.88 Mo I	
12	3754.86 Sm II		12	3757.79 Zr II		18	3760.88 U	
9 c	3754.98 Pr		30	3757.82 Nd II		28	3760.92 Gd II	
28	3755.09 Ru I		13	3757.86 Ce II		5	3761.11 Th	
15	3755.10 Mo I		40 d	3757.90 Tb II		22	3761.12 Eu II	
9	3755.11 Ta I		60	3757.92 W I		32	3761.12 Tb I	
9	3755.21 Th I		100	3757.94 Gd I		18	3761.13 Nb I	
8	3755.24 Gd II		5	3758.04 Cr I		240	3761.32 Ti II	
100	3755.24 Tb II		300	3758.24 Fe I		500	3761.33 Tm II	
4	3755.28 Nb I		140	3758.31 Gd II		5	3761.44 V I	
60	3755.28 Sm II		36	3758.36 U I		3.5	3761.47 Th I	
16	3755.43 Ce II		34	3758.45 Sm II		55	3761.51 Ru I	
6	3755.45 Co I		9	3758.46 Th I		8	3761.58 Nd	
26	3755.48 U		20	3758.52 Mo I		3.0	3761.61 W I	
3.5	3755.54 Mo I		55	3758.95 Nd II		10	3761.76 Mo I	
8	3755.56 Gd II		8	3758.97 Dy II		70	3761.87 Pr II	
42	3755.58 Rh I		50	3758.97 Sm II		4	3761.89 Ti II	
22	3755.60 Nd II		80	3759.00 Gd II		400	3761.91 Tm II	
8	3755.62 Re I		280	3759.08 La II		20	3761.94 Er	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
12	3761.96 U		10	3765.56 Hf I		4	3769.07 V I	
6	3762.09 Mo I		6	3765.74 Mo I		38	3769.09 Ho I	
5	3762.09 Nd		6	3765.85 Tm II		18	3769.15 Nb I	
5	3762.11 Ta I		7	3765.89 Ce II		14	3769.21 W I	
12	3762.11 U		7	3765.92 Nd		8	3769.43 Tb I	
85	3762.20 Gd I		8	3765.93 Eu II		60	3769.45 Gd II	
3.5	3762.37 Pr		3.0	3765.99 Pr		24	3769.54 U	
4	3762.45 Nb I		26	3766.13 Nb I		30	3769.65 Nd II	
6	3762.51 Hf II		20	3766.16 Er II		10	3769.70 Pr II	
6	3762.51 Tb I		13	3766.30 Os I		14	3769.87 W I	
3.0	3762.56 Pr		3.5	3766.35 Th		13	3769.94 Ce II	
50	3762.59 Sm II		5	3766.45 Ti I		42	3769.97 Rh I	
6	3762.74 Tb		6	3766.48 Pr		14	3769.98 Nb I	
36	3762.88 Th II		14	3766.48 Re I		7	3770.00 Mo I	
	3762.94 Th I		13	3766.51 Ce II		13	3770.05 Th I	
24	3762.98 Ce II		18	3766.59 Nd		55	3770.10 Yb I	
15	3763.00 Gd II		60	3766.72 Zr I		40	3770.45 Mo I	
6	3763.03 Pr		42	3766.82 Zr II			3770.52 Mo I	
9	3763.14 V I		32	3766.89 U I		6	3770.48 Pr	
24	3763.27 U I		17	3766.92 Hf II		4	3770.52 Ta I	
3.5	3763.32 Th II		85	3767.04 Gd II		140	3770.69 Gd II	
20	3763.33 Gd II		120	3767.19 Fe I		8	3770.71 Nb I	
16	3763.35 Mo I		55	3767.35 Ru I		5	3770.73 Ir I	
55	3763.47 Nd II		36	3767.36 Sm II		10	3770.73 Sm II	
55	3763.49 Nb I		2.0	3767.43 Cr I		17	3770.77 Ce	
7	3763.61 Ce II		18	3767.50 Tb II		14	3770.87 Nb I	
170	3763.79 Fe I		55	3767.63 Dy I		5	3770.93 Ta I	
8	3763.96 Tb I		3.5	3767.73 Mo I		22	3770.97 V II	
3.0	3764.09 Pr		6	3767.76 Er II		4	3771.03 Tb	
55	3764.12 Ce II		36	3767.76 Sm II		28	3771.08 Dy I	
16	3764.12 Nb I		8	3767.85 W I		24	3771.10 Er II	
36	3764.20 Gd II		3	3767.88 Zr II		24	3771.26 Gd I	
8	3764.31 W I		14	3767.90 Th I		6	3771.35 Sm II	
85	3764.37 Sm II		4	3768.00 Ce II		6	3771.36 Hf II	
60	3764.39 Zr I		12	3768.14 Os I		14	3771.37 Th I	
6	3764.44 Mo I		22	3768.24 Cr I		8	3771.38 Dy I	
36	3764.57 U		20	3768.25 Hf I		24	3771.61 Ce II	
16	3764.60 Gd II		12	3768.26 Re I		50	3771.66 Ti I	
24	3764.81 Pr II		850	3768.39 Gd II		55	3771.85 Nb I	
16	3765.04 Ce II		120	3768.45 W I		20	3771.95 Mo I	
10	3765.05 Hf I		7	3768.62 Mo I		7	3772.24 Th II	
36	3765.08 Nb I		7	3768.68 Ir I		28	3772.40 Ho I	
200	3765.08 Rh I		6	3768.71 Nd		8	3772.40 Nd I	
160	3765.14 Tb I		8	3768.73 Cr I		8	3772.42 W I	
10	3765.22 Mo I		7	3768.74 Mo I		10	3772.47 Er II	
8	3765.24 Th I		24	3768.76 Ce II		16	3772.64 Sm II	
7	3765.34 Nd II		14	3768.79 Er		5	3772.65 Ce II	
20	3765.35 U I		18	3768.80 U		14	3772.65 Dy I	
10	3765.43 Sm II		24	3768.93 Pr II		18 d	3772.76 Pr	
14	3765.54 Fe I		8	3769.04 Ce II			3772.84 Pr II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
16	3772.82 Mo I		4	3775.72 V I		6	3778.75 Pr	
14	3772.82 U		5	3775.91 Th II		9	3779.05 U	
8	3772.93 Nd		18	3775.99 U II		8	3779.09 Dy II	
55	3773.05 Dy I		2.5	3776.06 Ti II		30	3779.22 Tb	
9	3773.12 La II		8	3776.09 Pr I		13	3779.23 Dy II	
6	3773.12 Hf I		3.5	3776.10 Mo I		42	3779.47 Nd II	
11	3773.15 Nb I		6	3776.15 Ce		10	3779.56 Sm II	
5	3773.17 Ru I		28	3776.15 Ho I		3.5	3779.61 Ce II	
11	3773.18 Nd		4	3776.16 V I		5	3779.65 V I	
7	3773.21 Ce II		12	3776.25 Os I		24	3779.77 Mo I	
20	3773.31 Dy II		6	3776.27 Th I		10	3779.83 Gd II	
28 d	3773.33 Sm I		15	3776.34 Nd		9	3780.27 Pr II	
	3773.42 Sm II		1.0	3776.46 Fe I		8	3780.33 Dy I	
6	3773.44 Ce II		22	3776.48 U		32	3780.37 Ho II	
40	3773.44 U I		190	3776.49 Tb II		34	3780.40 Nd II	
20	3773.45 Gd I		3.5	3776.55 Mo I		90	3780.54 Zr I	
40	3773.70 W I		160	3776.56 Y II		18	3780.66 Pr II	
6	3773.74 Dy I		4	3776.60 Nb I		14	3780.67 La II	
12	3773.74 Th II		20	3776.61 Ce II		28	3780.72 U II	
12	3773.83 Ho I		20	3776.83 Gd I		50	3780.76 Sm II	
18	3774.06 Pr II		8	3776.93 Dy II		120	3780.77 W I	
3.5	3774.10 Eu I		28	3776.99 Os I		8	3780.93 Dy I	
4	3774.11 V I		8	3777.00 Nd		32	3780.93 Sm II	
3.5	3774.19 Th II		7	3777.08 Sm II		3.5	3780.97 Th I	
22	3774.29 Sm II		6 c	3777.10 Pr		12 c	3780.99 Ho II	
16	3774.30 Gd II		12	3777.10 Ta I		90	3781.01 Nb I	
8	3774.32 Yb I		5	3777.28 Nb I		36	3781.03 Er II	
1200	3774.33 Y II		1.8	3777.41 Th I		2.0	3781.10 Ce II	
12	3774.40 Os I		19	3777.45 Dy I		7	3781.15 Tm I	
7	3774.44 Nb I		11	3777.48 Tb		42	3781.18 Ru I	
24	3774.58 Ho I		1.6	3777.54 Co I		1.8	3781.31 Th I	
3.0	3774.60 Co I		140	3777.59 Ru I		30	3781.32 Nd II	
11	3774.62 Os I		14	3777.62 Er II		11	3781.38 Nb II	
14	3774.68 Sm II		14	3777.63 Pr II		4	3781.39 V I	
32	3774.75 Dy I		140	3777.64 Hf I		5	3781.40 Eu II	
8	3774.83 Er I		14	3777.66 Re I		36	3781.48 Dy I	
1.0	3774.83 Fe I		11	3777.67 Ce II		40	3781.59 Mo I	
20	3774.90 Ho I		6	3777.67 Nb I		50	3781.62 Ce II	
6	3774.93 Nd		7	3777.72 Mo I		9	3781.75 U I	
4	3775.19 V I		10	3777.84 Sm II		3.0	3781.93 Pr	
15	3775.26 Tb		6	3777.96 Mo I		6	3782.18 Tb	
10	3775.28 Er I		15 hc	3778.00 Ho I		7	3782.19 Mo I	
15	3775.37 Ho I		32	3778.13 Rh I		200	3782.20 Os I	
14	3775.45 Nb I		85	3778.14 Sm II		6	3782.22 Zr II	
80	3775.50 Nd II		10	3778.26 Er II		6	3782.30 Y II	
60	3775.57 Ni I		9	3778.59 W I		100	3782.34 Gd II	
3.5	3775.65 Mo I		12	3778.64 Er I		5	3782.35 Pr	
20	3775.66 Er II		28	3778.68 V I		7	3782.42 Sm II	
6	3775.72 Rh I		9	3778.68 W I		3.5	3782.43 Hf I	
1200 cw	3775.72 Tl I		14	3778.70 Ru I		36	3782.53 Ce II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
5	3782.62 Tb I		360	3786.06 Ru I		8	3789.11 Os I	
12	3782.65 Ho II		2.5 h	3786.18 Lu I		22	3789.11 Th II	
3.5	3782.68 Sm I		280	3786.21 Dy II		10	3789.30 Ti I	
55	3782.74 Ru I		14	3786.22 Nb I		7	3789.50 Nb I	
7	3782.78 Hf II		4	3786.38 W I		11	3789.68 Tb	
140	3782.84 U II		9	3786.57 U		38	3789.92 Tb	
16	3782.88 Dy II		12	3786.61 Zr		6	3790.10 Fe I	
12	3783.01 Th II		70	3786.63 Ce II		60	3790.14 Os I	
8	3783.04 Ce II		3.0	3786.68 Fe I		140	3790.15 Nb I	
280	3783.05 Gd I		10	3786.83 Dy I		30	3790.22 Mn I	
7	3783.06 Sm II		160	3786.84 Er II		9	3790.22 U	
10	3783.29 Th II		18	3786.84 U		55	3790.32 V I	
10	3783.36 Sm II		16	3786.88 Pr II		9	3790.33 U	
5 c	3783.40 Pr		5	3786.88 Th II		2.0	3790.34 Ce II	
6	3783.53 Mo I		4	3787.01 Tm I		6 h	3790.35 Th I	
70	3783.53 Ni I		180	3787.06 Nb I		8	3790.45 Cr I	
55	3783.54 Tb		7	3787.14 V I		550	3790.51 Ru I	
22	3783.56 Tm II		17	3787.15 Gd I		4	3790.60 Pr	
16	3783.58 Ce II		24	3787.20 Sm II		19	3790.63 Gd I	
13	3783.59 Dy II		38 d	3787.22 Tb		17	3790.73 Os I	
6	3783.73 Gd II		14	3787.23 U		14	3790.79 Th I	
6	3783.73 W I		11	3787.26 Dy II		6 d	3790.81 Ce	
18	3783.78 Nd		3.5	3787.37 Hf I			3790.88 Ce II	
14	3783.84 Nb I		6	3787.42 Er		440	3790.83 La II	
32	3783.84 U II		3.0	3787.46 Ce II		30	3791.00 Ho II	
6	3783.85 Er		7	3787.48 Nb I		11	3791.07 Tb	
3.5	3783.86 Pr		70	3787.52 Re I		10	3791.16 Er	
	3783.99 Pr		110	3787.56 Gd II		75	3791.17 Gd II	
13	3783.96 Dy I		8	3787.57 Ce II		360	3791.21 Nb I	
5	3784.15 Tb I		11	3787.60 Tb		20	3791.28 Sm II	
140	3784.25 Nd II		8	3787.71 Tb I		5	3791.29 Th II	
2	3784.25 Ta I		46	3787.88 Fe I		11	3791.38 Cr I	
16	3784.73 Nd		50	3787.90 Er II		70	3791.40 Zr I	
8	3784.81 La II		10	3787.91 Ce II		4	3791.50 Eu II	
11	3784.85 Nd II		2.5	3788.06 Pr		20	3791.50 Nd II	
10	3785.03 Mo I		36	3788.08 Ho II		8	3791.53 Er	
9	3785.11 Nd II		110	3788.12 Sm II		24	3791.55 Ho	
20	3785.23 Ho II		14	3788.16 U		7	3791.69 Ce II	
14	3785.35 Sm II		3.5	3788.21 Ce II		8	3791.72 Gd II	
11	3785.38 Tb		10	3788.26 Mo I		6 h	3791.74 Yb I	
7	3785.40 Nd		3.5	3788.35 Th II		50	3791.84 Er II	
28	3785.42 Dy II		12	3788.44 Ho II		60	3791.86 Dy II	
140	3785.46 Hf I		140	3788.46 Dy II		12	3791.97 Ho	
15	3785.50 Pr II		85	3788.47 Rh I		20	3792.02 Sm II	
6	3785.51 Mo I		850	3788.70 Y II		12	3792.02 Ta I	
24	3785.60 Th II		42	3788.75 Ce II		11	3792.14 Cr I	
3.5	3785.91 Th II		3.5	3788.76 Eu II		110	3792.18 Rh I	
3.0	3785.95 Fe I		8	3788.86 Cr I		36	3792.18 Tb	
4	3785.97 Pr		7	3788.97 Nd		24	3792.33 Ce II	
70	3786.04 Ti I		15	3789.00 Tb		8	3792.38 Th I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
48	3792.39 Gd II		8	3795.67 Os I		700	3798.90 Ru I	
11	3792.40 Zr I		16	3795.75 Gd I		18	3798.95 Tb II	
9	3792.41 U II		600	3795.76 Tm II		11	3799.01 Eu II	
22	3792.52 Pr II		5	3795.77 Pr		8 h	3799.04 Ce II	
20	3792.77 W I		6	3795.90 Ti I			3799.10 Ce II	
44	3792.81 Er I		12	3795.93 Gd II		160	3799.19 Pd I	
9	3792.81 Nd		6	3796.04 Mo I		18	3799.20 U II	
5	3792.93 Pr		12	3796.20 Tb		10	3799.24 Nd	
32	3792.95 Ho		18	3796.20 U		6	3799.26 Mn I	
42	3793.10 U II		4	3796.28 W I		420	3799.31 Rh I	
320	3793.22 Rh I		4	3796.30 Pr		700	3799.35 Ru I	
28	3793.28 U		500	3796.37 Gd II		38	3799.54 Sm II	
10	3793.29 Cr I		11	3796.44 Nb I		48	3799.55 Fe I	
7	3793.30 Tb		16	3796.48 Zr II		14	3799.55 Nd	
65	3793.37 Hf II		7	3796.49 Nd		18	3799.55 U	
6	3793.42 Pr		18	3796.54 U		60	3799.91 V I	
8 d	3793.52 Ce II		11	3796.59 Nb I		320	3800.12 Ir I	
55	3793.55 Tb		16	3796.59 Re I		28	3800.26 Ru I	
28	3793.57 U		4	3796.67 Ce II		70	3800.30 Pr II	
10	3793.61 V I		4	3796.72 Th I		20	3800.37 Sm II	
12	3793.62 Mo I		1000 c	3796.75 Ho I		85 d	3800.38 Hf I	
12	3793.79 Ir I		18	3796.84 U			3800.45 Hf I	
3.5	3793.86 Ce II		11	3796.85 Nb I		12	3800.55 Mn I	
11	3793.88 Cr I		7	3796.98 Tb		12	3800.67 Lu I	
36	3793.91 Os I		50	3797.07 Er II		60	3800.89 Sm II	
120	3793.97 Sm II		12	3797.13 Cr I		18	3800.94 Nb I	
3.5	3794.06 Ir I		22	3797.26 Ho I		280	3801.02 Sn I	
7	3794.15 Th II		32	3797.28 Sm II		2.0	3801.05 Pt	
3.0	3794.34 Fe I		28	3797.30 Mo I		22	3801.12 Nd	
10	3794.34 W I		3.0	3797.45 Th II		18	3801.15 U I	
10	3794.43 Mo I		6	3797.52 Fe I		32 c	3801.28 Ho II	
9	3794.47 Nb I		16	3797.59 Re I		70	3801.29 Gd II	
7	3794.61 Cr I		17	3797.72 Cr I		28	3801.30 Nb I	
4	3794.66 Os I		120	3797.73 Sm II		10 c	3801.35 Pr	
8	3794.68 Ce II		14	3797.77 U		6	3801.36 Eu	
20	3794.69 Ho I		70	3798.05 Ru I		7 h	3801.36 Tb	
4	3794.69 Th I		4	3798.10 Th I		12	3801.38 Nd II	
460	3794.78 La II		280	3798.12 Nb I		9	3801.44 Th I	
22	3794.92 Ru I		7	3798.24 Er		8	3801.52 W I	
20	3794.95 Pr		24	3798.25 Ho II		200	3801.53 Ce II	
120	3794.96 V I		3200	3798.25 Mo I		30	3801.80 Tb II	
65	3795.00 Fe I		5	3798.31 Ti I		32	3801.84 Mo I	
16	3795.13 U		16	3798.39 Gd II		6	3801.91 Mn I	
32	3795.17 Tm II		32	3798.51 Fe I		10	3801.92 W I	
8	3795.18 Ru I		65	3798.54 Tm I		10	3801.93 Dy II	
8	3795.25 Gd II		15	3798.59 Tb		6	3802.07 Tm I	
14	3795.26 Ce II		16	3798.65 Er I		2.0	3802.14 Th II	
6	3795.38 Th		10	3798.66 Hf I		15	3802.17 Tb II	
20	3795.45 Nd II		20	3798.75 Tm II		18	3802.27 U	
14	3795.54 Nb I		18	3798.84 U		20	3802.30 Nd	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
3	3802.30 Pr		110	3806.76 Rh I		3.0	3810.10 Ce II	
15	3802.85 Gd II		10	3806.77 Sm II		7	3810.10 U	
280	3802.92 Nb I		20	3806.80 V I		4	3810.25 Gd II	
42	3803.07 Th I		9	3806.83 Cr I		140	3810.33 Er I	
65	3803.10 Ce II		70 d	3806.85 Tb		22	3810.38 W I	
8	3803.20 Ru I		7	3807.09 Er II		32	3810.43 Sm II	
9	3803.35 U		70	3807.14 Ni I		70	3810.49 Nb I	
70	3803.47 Nd II		28	3807.23 Nd II		34	3810.49 Nd II	
60	3803.47 V I		32	3807.50 V I		3.5 d	3810.57 Tb	
6	3803.68 Er I		8	3807.54 Eu II		6	3810.69 Mn I	
9 d	3803.78 V I		3.0	3807.54 Fe I		32	3810.72 Tm II	
	3803.90 V I		15	3807.65 Gd II		1000 c	3810.73 Ho I	
4	3803.84 Ce II		6	3807.65 Mo I		30	3810.80 W I	
70	3803.88 Nb I		10	3807.69 Ce II		8	3810.90 Ce II	
12	3803.94 Sm I		50	3807.72 Tm I		7	3810.99 Th I	
6	3803.98 Th I		19	3807.74 Re I		55	3811.03 Nb I	
3.0	3804.08 W I		26	3807.87 Th II		14	3811.06 Nd II	
12	3804.10 Nd		9	3807.90 Dy		10	3811.33 Eu I	
44	3804.14 Dy II		12	3807.90 Ho		10	3811.39 Mo I	
28	3804.15 Ho		14	3807.92 Sm II		5	3811.62 Ce II	
4	3804.16 Ce II		9	3807.93 Cr I		22	3811.65 Tb I	
10	3804.33 Dy II		3.0	3808.11 Co I		16	3811.77 Nd II	
20	3804.39 Gd I		85	3808.12 Ce II		32	3811.78 Hf I	
11	3804.42 Tb		12	3808.20 Zr		40	3811.85 Pr	
10	3804.52 Mo I		8	3808.25 Nd		55	3811.86 Ho I	
7	3804.53 Hf I		32	3808.46 Sm II		140	3812.00 U I	
55	3804.74 Nb I, II		55	3808.52 V I		38	3812.07 Sm II	
44	3804.80 Cr I		4	3808.61 Th I		20	3812.21 Ce II	
30	3804.85 Pr II		28	3808.68 Ru I		40	3812.30 Dy I	
20	3805.09 Gd II		32	3808.77 Nd II		2.0	3812.40 Th I	
12	3805.34 Fe I		8	3808.79 La II		8	3812.45 Rh I	
150	3805.36 Nd II		28	3808.93 U I		10	3812.47 Mo I	
55	3805.52 Gd II		24	3809.05 Dy II		12	3812.53 Nd	
20	3805.55 Nd II		26	3809.06 Nd II		9	3812.58 U	
24	3805.63 Sm II		14	3809.16 Pr II		55	3812.72 Ru I	
8	3805.81 Th II		40	3809.22 Ce II		22	3812.73 Tb	
65	3805.92 Rh I		28	3809.22 U II		32	3812.96 Fe I	
10	3805.93 Mo I		34	3809.23 W I		24	3813.07 Th II	
	3805.99 Mo I		15	3809.49 Ho II		14	3813.13 Dy	
2.0	3806.04 Sm II		6	3809.50 Ce II		22	3813.16 Tb	
14	3806.07 Hf II		4	3809.50 Rh I		100 c	3813.25 Ho II	
4	3806.11 Er		80	3809.59 Mn I		3.5	3813.47 Nb I	
6	3806.13 Pr		24	3809.60 V I		110	3813.49 V I	
18	3806.20 Nb I		24	3809.75 Sm II		36	3813.63 Sm II	
50	3806.26 Dy II		4	3809.83 Th II		40	3813.67 Dy II	
9	3806.26 Tb		18	3809.84 Dy		28	3813.79 U II	
14	3806.47 Sm I		24	3809.88 Sm II		8	3813.83 Sm I	
6	3806.63 Nb I		12 c	3809.93 Ho II		4	3813.89 Pr	
6	3806.70 Fe I		15	3809.95 Dy		360	3813.97 Gd II	
360	3806.72 Mn I		6	3809.96 Pr		28	3814.07 U II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
3.0	3814.46 Co I		6	3818.22 Ti I		9	3821.85 Dy	
32	3814.63 Sm II		140	3818.24 V I		18	3821.95 U I	
42	3814.73 Nd II		70	3818.28 Pr II		60	3822.01 V I	
42	3814.74 Gd II		150	3818.35 Y II		5	3822.03 Ti I	
14	3814.86 Ru I		3.5	3818.36 Sm I		60	3822.09 Ru I	
3.0	3814.93 Ce II		6	3818.48 Cr I		12	3822.15 Th II	
14 d	3814.97 Tb		9	3818.48 U II		12	3822.17 Gd II	
7	3815.01 Ce II		7	3818.66 Mo I		320	3822.26 Rh I	
40	3815.01 Rh I		3.5	3818.68 Th I		9	3822.35 U	
3.0	3815.02 Th II		8	3818.69 Ce II		70	3822.41 Zr I	
15	3815.43 Cr I		20	3818.69 Ho II		24	3822.47 Nd II	
10	3815.50 Eu II		8	3818.69 Pt I		9	3822.56 U	
55	3815.51 Nb I		8	3818.71 Er		24	3822.57 Dy II	
10	3815.51 V I		4	3818.71 Pr		6	3822.80 Pr	
12	3815.66 Re I		10	3818.74 Dy		48	3822.89 V I	
4	3815.78 W I		42	3818.75 Gd II		18	3822.98 Mo I	
40	3815.83 Ce II		9	3818.76 U II		11	3823.12 Tb	
160	3815.84 Fe I		6	3818.84 Nd		16 c	3823.18 Pr II	
140	3816.17 Pr II		22	3818.86 Nb II		32	3823.21 V I	
20	3816.21 Dy		24	3819.02 Ce II		5	3823.26 Nd	
11	3816.27 Tb		70	3819.03 Ru I		240	3823.51 Mn I	
4	3816.31 Ce II		12	3819.07 Pr		6	3823.52 Pr I	
6	3816.33 Co I		22	3819.15 Nb I		6	3823.58 Th II	
7	3816.34 Nb I		9	3819.25 U I		10	3823.60 Ta I	
8	3816.39 W I		10	3819.38 Hf I		12	3823.70 Ce II	
5	3816.47 Co I		10	3819.44 Dy		44	3823.89 Mn I	
65	3816.47 Rh I		15	3819.56 Cr I		38	3823.90 Ce II	
9	3816.61 U		3400 cw	3819.67 Eu II		7	3823.99 V I	
75	3816.64 Gd II		14	3819.70 Nd		8	3824.00 Dy	
10	3816.75 Mn I		5	3819.77 Ru I		10	3824.07 Pr	
120	3816.78 Dy II		13	3819.87 Mo I		6	3824.14 Tb	
22	3816.90 Tb		24	3819.96 V I		12	3824.15 Gd I	
9	3817.16 U		14	3820.11 Tb II		4	3824.15 W I	
10	3817.20 Hf II		4	3820.11 W I		40	3824.18 Sm II	
24	3817.24 Ir I		500	3820.43 Fe I		11	3824.39 W I	
70	3817.27 Ru I		130	3820.73 Hf I		80	3824.44 Fe I	
11	3817.38 Nd II		70 d	3820.82 Sm		70	3824.88 Nb I	
46	3817.40 Tm II		7	3821.00 Tb		50	3824.93 Ru I	
38	3817.46 Ce II		7	3821.18 Fe I		7	3825.32 Mo I	
8	3817.47 Th I		3.5	3821.19 Nb I		24	3825.64 Ho	
160	3817.48 W I		9	3821.22 U		60	3825.65 Dy II	
16	3817.49 Dy		14	3821.27 Ce II		320	3825.88 Fe I	
26	3817.58 Zr II		12	3821.42 Th II		34	3826.05 Gd II	
12	3817.63 Pr		8	3821.49 Dy		4	3826.17 Ta I	
7	3817.73 Er		24	3821.49 V I		11	3826.19 W I	
15 d	3817.84 V I		6	3821.51 Gd II		120	3826.20 Sm II	
	3817.98 V I		5	3821.62 Tm I		10 c	3826.29 Pr II	
10	3817.87 Pr II		15	3821.70 Ce II		2.0	3826.36 Th I	
12	3818.06 U		34	3821.73 Ho II		24	3826.38 Tm I	
110	3818.19 Rh I		32	3821.82 Pr II		11	3826.42 Cr I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
70	3826.42 Nd II		11	3830.03 Cr I		22	3833.74 Ta II	
55	3826.51 U II		4	3830.06 Th I		160	3833.75 Mo I	
10	3826.56 Sm II		5	3830.27 V I		40	3833.83 Sm II	
10	3826.68 Eu II		40	3830.29 Sm II		36	3833.86 Mn I	
50	3826.70 Mo I		140	3830.29 Tb II		170	3833.89 Rh I	
12	3826.71 Pr II		30	3830.47 Nd II		17	3834.02 Tb I	
7 h	3826.74 Tb		320	3830.53 Er II		4	3834.04 W I	
5	3826.77 V I		38	3830.56 Ce II		130	3834.22 Fe I	
9	3826.85 Ta I		100	3830.72 Pr II		30	3834.22 V I	
8	3826.94 Th II		8	3830.77 Th I		100	3834.36 Mn I	
11	3827.01 Nb I		7	3830.82 Mo I		42	3834.48 Sm I	
8	3827.14 Os I		18	3830.98 Gd II		40	3834.56 Ce II	
9	3827.16 Mo I		8	3831.03 Dy		42	3834.60 Sm II	
8	3827.21 Ce II		3.5	3831.07 Mo I		4	3834.75 Rh I	
7	3827.27 Zr II		40	3831.08 Ce		7	3834.78 Ce II	
22	3827.33 Gd II		150	3831.46 U II		14	3834.92 Pr II	
6	3827.36 Er		85	3831.50 Sm II		4	3834.97 Mo I	
10	3827.38 Ce		18	3831.64 Dy II		32	3834.99 Gd II	
130	3827.82 Fe I		12	3831.69 Ni I		20	3835.05 Ru I	
14	3828.00 Nd II		19	3831.74 Th II		120	3835.05 W I	
18	3828.05 Sm II		3.5	3831.76 Mo I		19	3835.08 La II	
20	3828.19 Ti I		6	3831.76 Pr		18	3835.14 U	
3.5	3828.24 Nb II		36	3831.80 Gd II		36	3835.18 Nb I	
32	3828.38 Th I		70	3831.80 Ru I		9	3835.22 U	
200	3828.48 Rh I		18	3831.84 Nb II		7	3835.31 Mo I	
180	3828.56 V I		18	3831.86 U		46 c	3835.35 Ho II	
4	3828.71 Pr		36 cw	3831.9 Ho II		8	3835.56 V I	
12	3828.71 Ru I		14	3832.11 Mo I		7	3835.65 Er	
32	3828.85 Nd II		9	3832.23 Ce		28	3835.72 Sm II	
90	3828.87 Mo I		160	3832.29 Pd I		4	3835.75 Ce II	
10	3828.95 Ta I		10	3832.30 Er		4	3835.90 Ce	
18	3829.03 U		300	3832.31 Mg I		15 h	3835.92 U	
6 h	3829.07 Lu I		7	3832.46 Er		280	3835.96 Zr I	
12	3829.13 W I		7	3832.65 Tb		8	3836.05 V I	
26	3829.16 Nd II		8	3832.75 Ce II		24	3836.06 Os I	
44	3829.27 Ho I		6	3832.76 Nd		22	3836.11 Ce II	
11	3829.33 Th II		8	3832.81 Sm I		12	3836.30 Re I	
140	3829.35 Mg I		3.0	3832.84 V I		26	3836.45 Nb I	
3.5 c	3829.35 Pr		460	3832.88 Y II		200	3836.50 Dy II	
14	3829.39 U		13	3832.91 Dy		44	3836.54 Nd II	
22	3829.40 Gd II		20	3832.97 Gd I		9	3836.54 Th I	
14	3829.67 Hf I		3.5	3832.97 Th II			3836.58 Th I	
15	3829.68 Mn I		15	3833.02 U		7	3836.60 Ta I	
13	3829.69 Ce II		8	3833.04 Pr		160	3836.76 Zr II	
16	3829.75 Dy		24	3833.07 Sc II		8	3836.78 Ti I	
9	3829.79 U I		3.5	3833.26 Nb I		95	3836.91 Gd II	
3.5	3830.00 Nb I		3.0	3833.31 Fe I		7	3837.08 Nb I	
3.5	3830.00 Ta II		50	3833.40 Tb I		7	3837.18 Tb I	
28	3830.02 Hf I		8	3833.60 Pr		9	3837.21 Ce II	
14	3830.03 Ce II		8	3833.68 Ti I		9	3837.27 U	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
140 cw	3837.51	Ho II	120	3841.32	Dy II	9 h	3845.12	U
18	3837.66	Er	2.5	3841.46	Co I	5	3845.28	Ce II
14	3837.83	Tb	10	3841.72	Ce II	28	3845.32	U
18	3837.87	Th I	18	3841.81	Nb I	300	3845.47	Co I
20	3837.91	Nd II	12	3841.89	V I	12	3845.47	Gd II
28	3838.07	Ru I	24 h	3841.95	Nd	8	3845.48	Ce II
15	3838.15	U	20	3841.96	Th II	34 d	3845.61	Tb II
110	3838.20	Tm II	28	3842.02	Dy I	6	3845.74	Nd
500	3838.26	Mg I	4	3842.05	Ce II	22	3845.90	Nb I
14	3838.28	Zr II	60	3842.05	Co I	11	3845.95	Mo I
24	3838.36	Ho II	46 c	3842.05	Ho II	12	3846.00	La II
10	3838.39	Er	120	3842.20	Gd II	80	3846.21	W I
32	3838.50	W I	10	3842.30	W I	9	3846.24	U
90	3838.54	Ce II	28	3842.36	Pr II	2.0	3846.25	Th II
14	3838.67	Dy II	20	3842.36	Sm II	5	3846.28	Sm I
4	3838.90	Gd I	85 d	3842.50	Tb II	36	3846.33	Dy II
38	3838.94	Sm II	14	3842.71	Nb I	5	3846.45	Ti I
100	3838.98	Nd II	6	3842.90	Th II	15	3846.49	Gd I
17	3839.00	V I		3843.02	Th I	18	3846.52	Ce II
9	3839.03	Ta I	17	3842.98	Tb	18	3846.55	U I
3.5	3839.26	Fe I	3.5	3842.99	Er	60	3846.61	Pr II
12	3839.38	V I	9	3842.99	U	4	3846.64	Ta I
8	3839.39	Er	50	3843.02	Zr II	44	3846.68	Ru I
10	3839.50	Ce II	55	3843.03	Sc II	11	3846.71	Nd
20	3839.51	Nd II	8	3843.16	Ru I	55 c	3846.73	Ho II
90	3839.62	U I	6	3843.26	Fe I	12	3846.76	Sm I
100	3839.64	Gd II	140	3843.28	Gd I	6	3846.80	Fe I
85	3839.70	Ru I	6	3843.39	Pr	10	3846.91	Pr
60	3839.74	Th II	120	3843.50	Sm II	6	3846.97	Nd
26	3839.78	Mn I	8	3843.61	Lu I	36	3846.99	Dy I
10	3839.92	Yb I	7	3843.66	Os I	50	3847.01	Zr I
8	3840.14	V I	6	3843.76	Pr	36	3847.25	Mo I
12	3840.26	Gd I	16	3843.77	Ce II	34	3847.33	V I
13	3840.30	Os I	20	3843.77	Sm II	28	3847.49	W I
80	3840.44	Fe I	8	3843.80	Gd II	40	3847.51	Sm II
60	3840.44	V I	120	3843.86	Ho II	15	3847.84	U
30	3840.45	Sm II	6	3843.90	Mo I	7	3847.87	Y II
6	3840.61	Sm II	3.5	3843.93	Nb I	17	3847.88	Tb I
60	3840.72	La II	26	3843.98	Mn I	750	3848.02	Tm II
280	3840.75	V I	9	3844.00	U	11	3848.05	Ta I
6	3840.80	Th I	4	3844.04	Ta I	20	3848.11	Ce II
14	3840.82	Ru I	7	3844.08	Nb I	100 d	3848.24	Nd II
24	3840.87	Tm I	6	3844.18	Nd		3848.31	Nd II
32	3840.91	Dy I	12	3844.23	Eu II	18	3848.30	Mo I
50	3841.01	Pr II	9	3844.23	U	7	3848.32	Er
80	3841.05	Fe I	28	3844.30	Dy I	90	3848.52	Nd II
50	3841.08	Mn I	40	3844.44	V I	70	3848.60	Ce II
220	3841.18	Lu I	8 h	3844.50	Sm II	36 d	3848.62	U II
32	3841.28	Cr I	16 c	3844.56	Pr II		3848.72	U
13	3841.29	Os I	140	3844.58	Gd II	340	3848.76	Tb II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
48	3848.78	Sm II	100	3853.03	Dy II	36	3857.91	Sm II
16	3848.98	Cr I	11	3853.05	Ti I	4	3857.94	Ce II
160	3849.02	La II	5	3853.10	Tm II	14	3858.14	Ti I
80	3849.18	Hf I	70	3853.16	Ce II	12	3858.26	Pr II
50	3849.25	Zr I	10	3853.29	Lu I	130	3858.30	Ni I
8	3849.32	Er	40	3853.30	Sm I	60	3858.31	Hf I
12	3849.32	V I	11	3853.38	Nb I	48	3858.39	Er
12	3849.36	Cr I	11	3853.73	Ti I	36	3858.41	Dy I
28	3849.38	Dy II	200 c	3854.07	Ho II	13	3858.45	Gd I
4	3849.42	Ta I	13	3854.18	Gd II	14	3858.52	Sm I
8	3849.49	Ce	100	3854.19	Ce II	20	3858.55	Nd
14	3849.52	Hf II	200	3854.21	Sm II	7	3858.68	V I
5	3849.57	Ce II	16	3854.22	Cr I	30	3858.74	Sm I
4	3849.59	Tb I	46	3854.22	U I	30	3858.95	Nb I
9	3849.71	U	100	3854.32	Ce II	11	3859.14	Pr
15	3849.85	U II	28	3854.50	Th II	6	3859.22	Fe I
34	3849.88	Ho	36	3854.56	Sm I	16	3859.29	W I
48	3849.91	Er	180	3854.66	U II	28	3859.34	Ho
17	3849.94	Os I	3.5	3854.70	Nb I	8	3859.34	V I
50	3849.97	Fe I	13	3854.91	La II	7	3859.42	Nd
24	3850.04	Cr I	7	3855.15	Nb I	360	3859.58	U II
10	3850.12	Ce II	9	3855.29	Cr I	4	3859.80	Ta I
28	3850.22	Nd II	50	3855.30	Ce II	10	3859.85	Th II
70	3850.43	Ru I	130	3855.37	V I	420	3859.91	Fe I
320	3850.69	Gd II	7	3855.38	Tb I	20	3860.72	Ru I
7	3850.82	Fe I	10	3855.43	Zr II	3.5	3860.86	Nb I
120	3850.83	Pr II	7	3855.45	Nb I	20	3860.91	Hf I
500	3850.97	Gd II	16	3855.54	W I	16	3860.94	Nd
8	3851.17	V I	44	3855.56	Gd II	8	3861.06	W I
10 w	3851.37	Tb	12	3855.57	Cr I	15	3861.14	Gd II
26 h	3851.54	Ho	16	3855.58	Tb II	28	3861.16	Co I
3.0	3851.57	W II	320	3855.84	V I	36	3861.16	U
28	3851.60	Er	10	3855.88	Pr	4	3861.24	W I
75 c	3851.62	Pr II	60	3855.90	Sm II	8	3861.31	Pr II
140 d	3851.66	Nd II	60	3855.93	Er	300 c	3861.68	Ho II
	3851.74	Nd II	85	3856.37	Fe I	8	3862.05	Pr
9	3851.72	U I	44	3856.46	Ru I	50	3862.05	Sm II
24	3851.86	Tb II	500	3856.52	Rh I	16	3862.22	V I
32	3851.88	Sm II	44 cw	3856.94	Ho II	26	3862.23	Sm II
7	3851.99	Mo I	10 c	3857.00	Pr	16	3862.47	Ce II
4	3852.10	V I		3857.11	Pr	18	3862.52	Nd II
8	3852.11	Ce II	32	3857.02	Ce II	60	3862.62	Ho I
3.5	3852.11	Pr	20	3857.09	Os I	60	3862.69	Ru I
12	3852.14	Ru I	14	3857.24	Ce II	600	3862.82	Er I
6	3852.14	Th I	120	3857.55	Ru I	14 d	3862.93	Nb I
12	3852.22	Cr I	22	3857.63	Cr I		3863.05	Nb II
36	3852.40	Ho II	30	3857.64	Ce II	23	3863.05	Gd II
420	3852.45	Gd II	80	3857.72	Ho II	9	3863.09	U
2.0	3852.58	Fe I	6	3857.82	Ce II	220 d	3863.33	Nd II
100	3852.81	Pr II	10	3857.84	Tm II		3863.40	Nd II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
36	3863.38 Nb I		16	3868.14 Ce II		5	3873.26 Ce II	
32	3863.41 Th II		4	3868.22 Er		3.5	3873.40 Pr	
14 h	3863.42 Sm II		14	3868.40 Ti I		14	3873.47 Sm II	
14	3863.87 V I		9	3868.42 U II		24	3873.52 Ru I	
260	3863.87 Zr I		48	3868.46 Dy II		23	3873.57 Gd I	
11	3864.05 Sm II		13 h	3868.50 Ce II		7	3873.64 V I	
8	3864.06 Pr		7	3868.58 Pr II		3.5	3873.76 Fe I	
2800	3864.11 Mo I		140	3868.81 Dy I		19	3873.78 Tb II	
18	3864.30 U		13	3868.90 Tb II		26	3873.82 Th I	
20	3864.34 W I		50	3869.07 Nd II		120	3873.96 Co I	
70	3864.34 Zr I		55	3869.08 Mo I		100	3874.00 Dy II	
18	3864.48 U		8	3869.16 Pr		46	3874.04 U	
8	3864.49 La II		26	3869.43 Dy II		36 c	3874.09 Ho II	
12	3864.79 Gd I		5	3869.57 Ce II		320 w	3874.19 Tb II	
20	3864.81 Er		42 d	3869.75 Tb II		2.0	3874.39 Sm II	
140	3864.86 V I		70	3869.87 Dy II		12	3874.41 W I	
12	3864.91 Ho		10	3869.91 Pr		10	3874.45 Pr II	
7	3865.02 Nb II		24	3869.94 Re I		15	3874.46 Gd I	
	3865.04 Nb I		42	3870.01 Rh I		6	3874.53 Cr I	
24	3865.24 Sm II		18	3870.05 U		4	3874.61 Lu I	
7	3865.39 Ce		8	3870.35 Pr		22	3874.68 Ce II	
12	3865.40 Ru I		4	3870.58 V I		70	3874.68 Ho II	
18	3865.45 Dy II		22	3870.73 Pr		12	3874.73 Er	
50 c	3865.46 Pr II		13	3870.87 Ce II		18	3874.86 Th I	
20	3865.47 Os I		110	3871.04 U I		22	3875.04 Ce II	
34	3865.53 Fe I		18	3871.08 V I		160	3875.08 V I	
16	3865.57 Eu I		7	3871.19 Nb I		7	3875.15 Dy II	
18	3865.64 Ir I		13	3871.54 Gd II		30	3875.19 Sm II	
6	3865.69 Sm II		18	3871.64 Dy II		22	3875.22 Tb II	
140	3865.92 U II		340	3871.64 La II		24	3875.26 Re I	
10	3865.98 Nd II		60	3871.78 Sm II		22	3875.26 Ti I	
7	3866.05 W I		3.0	3871.81 Ce II		15	3875.37 Th I	
20	3866.44 Ti I		7	3871.88 U		3.5	3875.42 Nb I	
14	3866.52 Nd II		40	3872.05 Ho		20	3875.46 Gd II	
32	3866.59 Dy II		600	3872.13 Dy II		42	3875.54 Sm II	
3.5	3866.69 Mo I		6	3872.39 Rh I		2.0	3875.64 Th I	
28	3866.80 U		34	3872.50 Fe I		8	3875.68 W I	
13	3866.81 Nd II		18	3872.55 Hf II		14	3875.74 Nd II	
13	3866.82 Ce II		13	3872.62 Gd II		18	3875.76 Nb I	
150	3866.99 Gd I		4	3872.72 Eu I		8	3875.87 Er	
18	3867.17 U I		4	3872.72 Pr		28	3875.87 Nd II	
2.0	3867.22 Fe I		24	3872.72 Th II		44	3875.90 V I	
13	3867.26 Gd II		28	3872.83 W I		3	3876.08 Ru I	
7	3867.34 Hf II		20	3872.85 Yb I		60	3876.09 V I	
22	3867.55 Pr II		8	3873.00 Tb I		18	3876.13 U I	
24	3867.60 V I		5	3873.02 Pr		14	3876.14 Ce II	
8	3867.84 Dy II		5	3873.03 Ce		50	3876.18 Pr II	
120	3867.84 Ru I		240	3873.12 Co I		9	3876.59 U	
28	3867.92 Nb I		10	3873.21 Ti I		55	3876.65 Lu II	
200	3867.98 W I		10	3873.22 Sm II		6	3876.67 Tb I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
65	3876.77 Os I		75	3881.46 U II		2.5	3885.29 Co I	
8	3876.82 Y		12	3881.59 Nd		280	3885.29 Sm II	
12	3876.84 Co I		60	3881.61 Ho		4	3885.38 Er II	
24	3876.86 Re I		24	3881.76 Tb II		140	3885.42 Zr I	
14	3876.96 Nb I		34	3881.79 Sm II		110	3885.44 Nb I	
50	3876.97 Ce II		10	3881.84 Gd II		2.5	3885.51 Fe I	
14	3877.10 Hf II		22	3881.86 Os I		70	3885.68 Nb I	
12	3877.20 Sm II		14	3881.87 Ce II		4	3885.77 Th I	
180 c	3877.23 Pr II		34	3881.87 Co I		18	3885.91 Sm II	
6	3877.27 Eu II		26	3882.00 Dy II		22	3886.07 Nb I	
32	3877.34 Rh I		9	3882.01 Ru I		5 h	3886.09 Nd I	
18	3877.49 Sm I		14	3882.15 Ti I		180	3886.28 Fe I	
55	3877.56 Nb I		9	3882.32 Pr		170	3886.37 La II	
90	3877.60 Zr I		14	3882.33 Ti I		8	3886.50 Ce II	
50	3878.02 Fe I		36	3882.36 U II		7	3886.59 V I	
46	3878.09 U		120	3882.45 Ce II		3.5	3886.75 Os I	
12	3878.21 Tb II		24	3882.50 Sm II		32	3886.79 Cr I	
48	3878.28 Y II		18	3882.52 Hf I		55	3886.82 Mo I	
10	3878.31 Pr II		100	3882.87 Er II		24	3886.82 Tb II	
90	3878.37 Ce II		42	3882.89 Ti I		7	3886.91 Th I	
85	3878.58 Fe I		18	3883.10 U		7	3887.01 Th I	
65	3878.58 Nd II		500	3883.13 Tm I		35	3887.05 Fe I	
14	3878.71 V II		70	3883.14 Nb I		5	3887.11 Sm II	
90	3878.82 Nb I		55	3883.29 Cr I		12	3887.16 Er II	
	3878.97 Nb I		28	3883.33 U		7	3887.16 Gd II	
18	3879.05 Zr I		130	3883.44 Tm II		400	3887.35 Tm I	
10	3879.07 Ce II		11	3883.57 Ce II		13	3887.45 U	
40	3879.10 Dy II		4	3883.66 Cr I		8	3887.49 Re I	
28	3879.21 Pr II		6	3883.76 Nd		9	3887.55 Dy I	
5	3879.31 Ce II		13	3883.77 Hf II		15 d	3887.64 Tb II	
7	3879.35 Nb II		2.0	3883.80 Sm II		13	3887.70 U	
18	3879.53 U I		4	3883.83 W I		7	3887.73 Gd I	
60	3879.55 Nd II		3.0	3883.89 V I		9	3887.77 Ru I	
28	3879.59 Ho		12	3884.02 Ru I		3.0	3887.77 Y I	
5	3879.61 Ce II		4 h	3884.04 Pr II		32	3887.87 Nd II	
10	3879.64 Th I		8	3884.08 Er I		15	3887.88 Tb I	
18	3879.71 U		6	3884.08 Nd		8	3887.95 Re I	
9	3879.99 Tb I		8	3884.20 Ce II		5 h	3888.02 Ti I	
9	3880.35 Tb I		4	3884.52 Th II		3.5	3888.06 Pr	
46	3880.38 Nd II		5	3884.62 Co I		20	3888.09 Er II	
5	3880.41 Ce II		6	3884.66 Gd II		7	3888.18 Mo I	
70	3880.47 Pr II		9	3884.68 Ru I		44	3888.23 Tb I	
120	3880.60 Er II		18	3884.68 U		5	3888.29 Pr	
60	3880.77 Sm II		6	3884.74 Nd		6	3888.34 Rh I	
70	3880.78 Nd II		13	3884.75 Eu I		18	3888.39 Ce II	
8	3880.78 Pr		10	3884.82 Th II		16	3888.45 Dy II	
34	3880.82 Hf II		18	3885.10 Tb I		35	3888.52 Fe I	
9	3881.29 Tb I		46 c	3885.19 Pr II		7	3888.88 Mo I	
34	3881.38 Sm II		11	3885.20 Ta I		14	3888.93 Gd I	
80	3881.39 W I		48	3885.22 Cr I		340 c	3888.96 Ho II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
10	3889.00 Ce II		2.0	3891.72 Th I		140	3894.70 Gd II	
16	3889.01 Dy II		4	3891.77 Ce II		4	3894.70 Nb I	
50	3889.16 Sm II		140 l	3891.78 Ba II		3	3894.94 Pr	
	3889.22 Sm II		18	3891.82 U		8	3894.97 Sc	
18	3889.23 Hf I		24	3891.85 Dy II		24	3894.98 Co I	
6	3889.30 Ce II		5	3891.93 Cr I		5	3895.08 Pr II	
7	3889.33 Ba I		9 h	3892.03 Zr I		6	3895.08 Tb I	
18	3889.33 Hf I		28	3892.06 Nd II		3.5	3895.09 Sm II	
46 c	3889.33 Pr II		1.2	3892.12 Co I		50	3895.12 Ce II	
	3889.42 Pr		60	3892.21 Ru I		3.5	3895.18 Os I	
6	3889.48 Ce II		3.5	3892.30 Th II		16	3895.23 Gd II	
4	3889.63 Nb I		18	3892.41 U		17 h	3895.25 Ti I	
22 h	3889.66 Nd II		6	3892.47 Hf I		15	3895.27 U II	
3.5	3889.67 Ni I		5	3892.52 Pr		14	3895.34 Dy II	
3	3889.80 Nb I		3.0	3892.66 Ba I		8	3895.37 Nd II	
12	3889.82 Er II		46	3892.68 U II		6	3895.39 Tb I	
9	3889.84 Tb II		340	3892.69 Er I		3.5	3895.42 Sm II	
75	3889.93 Nd II		4	3892.72 Gd I		24	3895.42 Th I	
6	3889.95 Ti I		12	3892.72 W I		35	3895.66 Fe I	
7	3889.96 Re I		3	3892.77 Ru I		42	3895.79 Gd II	
2.5 h	3889.97 Pr		36	3892.86 V I		13	3895.81 Er II	
85	3889.99 Ce II		24	3892.87 Dy I		18	3895.90 Nb I	
46	3890.08 Sm II		2.0	3893.03 Ta I		5	3895.91 Nd	
55	3890.18 V I		1.2 h	3893.07 Co I		30	3895.99 Tb II	
14	3890.20 Ru I		32 c	3893.08 Ho II		8	3896.11 Re I	
10	3890.22 Nd II		4	3893.11 Th II		16	3896.13 Nd II	
260	3890.32 Zr I		14	3893.23 Ce II		7	3896.16 V I	
160	3890.36 U II		3.5	3893.32 Mo I		420	3896.25 Er II	
8	3890.42 Gd I		15	3893.38 Tb II		3.5	3896.38 Mo I	
55	3890.42 Ho I		3.5	3893.39 Fe I		2.0bl	3896.43 Ta TaO	
32	3890.53 Tm II		2.0	3893.41 Th II		14	3896.53 Zr I	
75	3890.58 Nd II		11	3893.52 Ho II		30	3896.58 Tb II	
32	3890.60 Er II		6	3893.69 Tb I		32	3896.62 Tm I	
3.5	3890.71 Mo I		5	3893.73 Nb I		60	3896.76 Ho II	
4	3890.74 W I		7 h	3893.84 Zr I		2.0	3896.78 Eu I	
17	3890.76 Ce II		6	3893.87 Ce II		36	3896.78 U II	
5	3890.85 Gd II		5	3894.03 Nb I		48	3896.80 Ce II	
75	3890.94 Nd II		22	3894.04 Cr I		4	3896.84 Pr II	
6	3890.95 Tb I		7	3894.04 V I		3.5	3896.85 Mo I	
17	3890.99 Ce II		30	3894.05 Sm II		120	3896.98 Sm II	
1500 c	3891.02 Ho II		340	3894.08 Co I		7	3897.04 Pr II	
6	3891.05 Th II		36	3894.12 U I		18	3897.06 U	
7 h	3891.12 V I		3.0	3894.14 Pr		7	3897.08 V I	
24	3891.21 Sm II		240	3894.20 Pd I		9	3897.24 Ru I	
60	3891.30 Nb I		3	3894.24 Ru I		3.5	3897.26 Sm II	
180	3891.38 Zr I		6	3894.32 Ce II		4	3897.26 Tb I	
6	3891.41 Ru I		15	3894.46 Tb II		14	3897.26 U	
34	3891.51 Nd II		7	3894.51 Dy I		30 c	3897.27 Ho II	
9	3891.68 U		45	3894.60 Tb I		20	3897.28 Pr II	
12 c	3891.70 Pr II		48	3894.63 Nd II		6	3897.32 Gd I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
4	3897.43 Ce II		3.0	3900.65 Hf II		4	3903.86 Er II	
26	3897.63 Nd II		4	3900.73 Pt I		1.8	3903.90 Fe I	
3.5	3897.65 Cr I		12	3900.74 Tb I		7	3903.91 Pr	
7	3897.66 Zr I		14	3900.79 Ho I		7	3903.93 Ce II	
9	3897.71 U		50	3900.79 Tm II		4	3903.98 W I	
4	3897.72 Pr		20	3900.86 Yb I		20	3903.99 Er I	
4	3897.89 Au I		24	3900.88 Th II		1.2 h	3904.05 Co I	
30	3897.89 Tb I		20	3900.89 Sm II		10	3904.08 Th II	
3.5	3897.90 Fe I		8	3900.91 Re I		7	3904.14 Tb I	
15 h	3897.91 W I		15	3900.96 Ti I		12	3904.18 Nb I	
3.5	3898.01 Fe I		4	3901.09 Re I		13	3904.21 Dy II	
22 h	3898.02 V I		4	3901.14 Th II		2.5	3904.22 Rh I	
40	3898.27 Ce II		11 h	3901.15 V I		22	3904.29 Gd I	
11	3898.28 Nb II		14	3901.24 Ru I		34	3904.30 U II	
9	3898.36 Ru I		10	3901.30 Ce II		20	3904.34 Ce II	
6	3898.43 Th I		8	3901.35 Dy I		36	3904.44 Ho I	
	3898.50 Th I		150	3901.35 Tb I		4	3904.47 V I	
1.2	3898.49 Co I		5	3901.68 Ce II		18	3904.56 U II	
7	3898.49 Ti I		9	3901.68 Tb II		4	3904.58 Ce II	
500	3898.54 Dy II		17	3901.71 Os I		20	3904.59 Er II	
11	3898.56 Nb I		36	3901.77 Mo I		6 h	3904.59 Y I	
5	3898.60 La I		4	3901.83 W I		220	3904.78 Ti I	
3.5	3898.78 Ta I		75	3901.84 Nd II		3.5	3904.80 Pr	
22	3898.84 Pr II		9 d	3902.00 Tb II		3.0	3904.82 Yb II	
22	3898.94 Ce II		3.0	3902.11 Cr I		9	3904.85 U	
20	3899.04 Er I		3.5	3902.12 Th II		12	3905.19 Th II	
14	3899.10 U II			3902.17 Th I		100	3905.44 Er I	
11	3899.13 V II		32	3902.23 Ho II		11	3905.53 Si I	
22	3899.15 Dy I		190	3902.25 V I		9	3905.56 Dy II	
220	3899.20 Tb II		5	3902.32 Sm II		6	3905.56 Nd	
7	3899.25 Nb I		70	3902.40 Gd II		42	3905.65 Gd I	
18	3899.27 U		26	3902.47 Pr II		140 cw	3905.68 Ho II	
4	3899.39 Ce II		30	3902.49 U II		100	3905.89 Nd II	
18	3899.42 U		50	3902.51 Ir I		9	3905.95 Dy I	
9 c	3899.56 Pr II		8	3902.51 Nd I		8	3905.97 W I	
15	3899.57 Tb II		3.5	3902.58 La I		8	3906.09 Nd II	
14	3899.64 Ho II		10	3902.66 Ir I		7	3906.09 Pr	
55	3899.71 Fe I		28	3902.71 Gd I		6	3906.29 Co I	
46	3899.78 U II		65	3902.75 Er II		850	3906.34 Er II	
55	3899.94 Hf I		30	3902.92 Cr I		28	3906.46 U	
2.0	3900.12 Th II		55	3902.95 Fe I		14	3906.48 Fe I	
2.0	3900.18 Eu I		1800	3902.96 Mo I		5	3906.54 Tb II	
11 h	3900.18 V I		3.0	3903.08 Tb I		8	3906.75 V I	
6	3900.20 Ce II		8	3903.10 Th I		4	3906.81 Sm II	
120	3900.21 Nd II		5	3903.16 Cr I		4	3906.89 Hf I	
12	3900.39 Os I		4	3903.26 V II		9	3906.91 Nb I	
6	3900.51 Eu I		7	3903.30 Dy I		14	3906.92 Ce II	
36	3900.52 Zr I		16	3903.34 Ce II		7	3906.92 Mo I	
44	3900.54 Ti II		100	3903.42 Sm II			3906.98 Mo I	
4	3900.57 Th I		7	3903.51 Nd		2400 cw	3907.10 Eu II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
6	3907.12 Gd I		13	3910.30 Ho I		13	3913.01 Nb I	
55	3907.29 Ce II		15	3910.43 Tb I		7	3913.01 Th II	
3.0	3907.30 Pr		9	3910.50 Er I			3913.08 Th I	
11	3907.45 Ce II		10	3910.70 Ce II		7	3913.36 Mo I	
1800	3907.49 Sc I		8	3910.79 V I		8	3913.37 Sm II	
6	3907.50 Nd		4	3910.81 La II		42	3913.46 Ti II	
12	3907.64 Nd		15	3910.85 Tb I		26	3913.48 Tb I	
3.0	3907.65 Os I		18	3910.89 U		10	3913.51 Rh I	
30	3907.84 Nd II		3.5	3910.92 Sm II		32	3913.56 Pr II	
80 c	3908.03 Pr II		7	3911.09 Mo I		11	3913.62 Dy I	
44	3908.08 Tb I		120	3911.16 Nd II		6	3913.62 Sm II	
7	3908.09 Ce II		9 h	3911.19 Ti I		20	3913.69 Nd II	
10	3908.21 Re I		8	3911.28 Yb I		6	3913.78 Gd II	
13	3908.25 Mo I		10	3911.30 Ce II		4	3913.82 Th II	
9	3908.33 U		4	3911.31 Pr		13	3913.92 Re I	
40	3908.41 Ce II		9	3911.58 Er II		13	3913.98 Dy II	
8	3908.42 Er I		4	3911.62 Gd I		8	3913.99 Ce II	
320	3908.43 Pr II		24	3911.67 U		14	3914.20 U	
9	3908.47 U		3.0	3911.77 Lu I		14	3914.27 U	
28	3908.54 Ce II		36	3911.80 Ho I		11	3914.33 V II	
4	3908.59 Nb I		3.5	3911.80 Pr		42	3914.34 Ti I	
6	3908.68 Tb I		3.0	3911.81 Os I		3.5	3914.34 Zr II	
3.5	3908.74 Th I		2100	3911.81 Sc I		14	3914.63 Tb I	
80	3908.76 Cr I		10 hd	3911.82 Cr I		70	3914.70 Nb I	
12	3908.76 Ru I			3912.00 Cr I		2.0	3914.74 Ti I	
8	3908.77 Ce		6	3911.91 Th I		22	3914.76 Pr II	
22	3908.97 Nb I		4	3911.92 Er II		14	3914.85 Ru I	
2.5	3909.05 Ce II		3.5	3911.94 Mo I		44	3914.86 Dy II	
9	3909.06 U		4	3911.99 Pr		7	3914.95 Ce II	
70	3909.08 Ru I		9	3912.11 Ru I		26	3915.13 Nd II	
2.0	3909.13 Th I		4	3912.13 Ta I		4	3915.24 Eu II	
35	3909.16 Tb I		16	3912.19 Ce II		50	3915.38 Ir I	
7	3909.18 Hf I		17	3912.21 V I		60	3915.43 Tb I	
4	3909.25 Gd I		50	3912.23 Nd II		10	3915.44 Mo I	
19	3909.31 Ce II		5	3912.27 Pr		18	3915.47 Pr II	
7	3909.33 Ta I		8	3912.28 Th II		28	3915.52 Ce II	
30	3909.54 Tb I		10	3912.30 Tb I		44	3915.58 Dy II	
7	3909.55 Mo I		11	3912.43 Er II		4	3915.70 Er II	
11	3909.56 Ho I		7	3912.44 Ce II		10	3915.84 Cr I	
7	3909.60 Nb I		12	3912.44 Ho II		28	3915.88 U II	
11	3909.62 Pr II		4	3912.44 Ta I		28	3915.94 Zr II	
9	3909.75 Ce II		10	3912.52 Dy I		36	3915.95 Nd II	
55	3909.89 V I		7	3912.61 Pr		7	3915.98 Er I	
10	3909.91 Ba I		7	3912.75 Gd I		4	3916.00 Eu I	
9	3909.93 Ce II		7	3912.77 Tb II		130	3916.05 La II	
7	3909.93 Co I		2.0	3912.83 Rh I		28	3916.14 Ce II	
6	3909.94 Gd I		7	3912.86 Dy II		16	3916.24 Cr I	
6	3909.95 Sm I		4	3912.89 V I		4	3916.36 Sm II	
6	3910.09 Sm II		65	3912.90 Pr II		8	3916.41 V II	
9	3910.14 Tb II		8	3912.98 Sm II		3.5	3916.42 Th I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
260	3916.48	Tm I	5	3918.86	Lu I	15	3922.78	Ta I
200	3916.51	Gd II	130 c	3918.86	Pr II	55	3922.91	Fe I
9	3916.53	U	5	3918.90	Nd	15	3922.92	Ta I
14	3916.64	Zr I	3.0	3918.97	Os I	11	3922.96	Pt I
6	3916.67	Tb I	7	3919.00	Nb I	9	3923.05	U
2.0	3916.73	Fe I	7	3919.00	Tb I	40	3923.11	Ce II
10	3916.79	Th II	8	3919.02	Th I	42	3923.25	Gd II
2.5	3916.80	Pr	9	3919.09	Eu II	11 c	3923.28	Ho II
10	3916.90	Ce II	11	3919.13	Dy I	14	3923.31	Tb II
4	3916.90	Tb I	160	3919.16	Cr I	26	3923.39	Dy II
7	3916.92	Mo I	7	3919.16	Nb I	140	3923.47	Ru I
6	3917.11	Co I	36	3919.45	Ho I	4	3923.51	Sc II
4	3917.18	Fe I	4	3919.47	Ta I	10	3923.56	Pr
10	3917.23	Pr II	44	3919.52	Tb II	11	3923.75	Mo I
5	3917.25	Ce II	44	3919.62	Pr II	2.0	3923.80	Th I
18	3917.25	U I	3.5	3919.72	Nb II	18	3923.90	Hf II
4	3917.26	Th I	34	3919.81	Ce II	13	3924.14	Pr II
38 c	3917.27	Re I	3.0	3919.82	Ti I	14	3924.27	U II
20	3917.29	Eu I	13	3919.92	Nd II	4	3924.37	W I
44 d	3917.30	Dy I	3.5	3920.10	Sm II	6 d	3924.42	Tb II
	3917.37	Dy I	55	3920.20	Nb I	9	3924.46	Dy II
7	3917.30	Tb I	36	3920.26	Fe I	7	3924.49	Nb I
42	3917.44	Sm II	8	3920.49	V I	8	3924.49	Nd II
7	3917.45	Hf II	26	3920.52	Pr II	90	3924.53	Ti I
14	3917.54	Mo I	14	3920.72	Tb II	11	3924.55	Ho II
3.0	3917.60	Cr I	6 c	3920.85	Re I	6	3924.63	Ru I
16	3917.64	Ce II	24	3920.92	Ru I	32	3924.64	Ce II
20	3917.65	Nd	65	3920.96	Nd II	19	3924.66	V I
2.0	3917.70	Eu II	50	3921.02	Cr I	4	3924.70	W I
7	3917.78	Mo I	24	3921.42	Ti I	5	3924.80	Ce II
9	3917.82	U	110	3921.54	La II	10	3924.81	Tb II
8 c	3917.92	Pr	14	3921.55	U	5	3924.98	Nd
22	3918.05	Er I	42	3921.73	Ce II	18	3925.00	Nb I
11	3918.06	Gd II	55	3921.79	Zr I	5	3925.00	Pr
6	3918.06	U II	22	3921.89	Er II	10	3925.09	Th I
6	3918.07	Th I	8	3921.90	V I	3.0	3925.10	Os I
55	3918.09	Hf II	3.0	3922.03	Os I	1.4	3925.16	Co I
11	3918.24	Gd II	13	3922.05	Sm II	20	3925.22	Sm I
5 h	3918.25	Y I	28	3922.10	Tb II	12	3925.24	V I
55	3918.28	Ce II	20	3922.19	Rh I	70	3925.45	Tb II
5	3918.32	Mn I	4	3922.22	Th II	100	3925.46	Pr II
17	3918.38	Er II	7	3922.25	Pr	5	3925.63	Nd
22	3918.51	Ta I	7	3922.32	Mo I	11	3925.64	Ho II
4	3918.51	Th II	11	3922.35	Nb I	300	3925.92	Ru I
3.5	3918.52	Eu I	170	3922.40	Sm II	4	3926.03	W I
9	3918.53	Dy II	6	3922.42	Ta II	24	3926.22	U I
8	3918.60	W I	18	3922.43	V I	9	3926.32	Ti I
13	3918.62	Sm II	6	3922.70	Sm II	11	3926.42	Hf I
3.0	3918.65	Fe I	44	3922.74	Tb II	9	3926.47	Mn I
9	3918.78	Tb II	3.5	3922.75	Co I	7	3926.61	Nb I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
3.5 h	3926.62	Lu I	5	3929.96	Ce II	22	3933.73	Ce II
4	3926.62	Nd II	9	3930.00	Os I	1.4	3933.91	Co I
2.5	3926.65	Cr I	20	3930.02	V I	20	3934.01	V I
10	3926.68	Gd I	6 h	3930.11	Y I	5	3934.08	Ce I
2.0	3926.70	Th II	44	3930.15	Dy I	9	3934.09	Nd II
24	3926.73	U I	7	3930.25	W I	18	3934.12	Zr II
3.0	3926.77	Os I	75	3930.30	Fe I	3.5	3934.14	Nb I
7 h	3926.78	Zr I	12	3930.43	U	26	3934.17	Dy II
2.5	3927.00	Ce II	2800 cw	3930.48	Eu II	170	3934.23	Rh I
30	3927.10	Nd II	9	3930.48	W I	6	3934.24	Ti I
8	3927.17	Th II	3.5	3930.62	Pr	5	3934.26	Pr
8	3927.39	Ce II	24	3930.66	Y II	10	3934.41	Nb I
8	3927.42	Th II	5	3930.76	Tb II	12	3934.41	Tb I
50	3927.45	Pr II	8	3930.81	Ce II	2.5	3934.75	Ce II
16	3927.56	La I	7	3930.94	Ta I	110	3934.79	Gd I
5	3927.57	Ce II	4	3930.97	W I		3934.82	Gd II
13	3927.57	Hf I	32	3930.98	U	18	3934.79	Zr II
7 c	3927.59	Re I	55	3931.09	Ce II	36	3934.82	Nd II
12	3927.71	Pr II	2.5	3931.16	Sm II	44	3934.84	Ir I
18	3927.76	U	6	3931.20	Re I	4	3934.98	Rh I
34	3927.88	Dy I	15	3931.28	Dy II	3.5	3935.02	Mo I
70	3927.92	Fe I	12	3931.34	V I	16	3935.04	W I
16	3927.93	V I	22	3931.37	Ce II	11 c	3935.13	Pr
130	3928.28	Sm II	28	3931.38	Hf I	12	3935.14	V I
11	3928.32	Ce II	3	3931.40	Mo I	3.5	3935.18	Sm II
4	3928.41	Os I	3.5	3931.46	Nb I	60	3935.24	Tb II
4	3928.54	Os I	7	3931.52	Os I	20	3935.38	Gd I
9	3928.62	Pr II	170	3931.55	Dy II	36	3935.38	U
50	3928.64	Cr I	55	3931.76	Ru I	9	3935.45	Nb I
9	3928.66	Tm II	16	3931.83	Ce	10 d	3935.54	Th II
6	3928.79	Mo I	4	3932.00	Th II		3935.63	Th II
9	3928.83	U	3.0	3932.02	Ti II	11	3935.65	Hf II
3.5	3928.87	Eu II	15	3932.03	U II	14	3935.72	Ba I
7	3928.91	Pr II	9	3932.05	Dy II	32	3935.76	Sm II
220	3929.22	La II	3.0	3932.13	Pr	2.0	3935.82	Fe I
1.2 h	3929.25	Co I	11	3932.15	Ce II	38	3935.82	Pr II
12	3929.26	Nd II	26	3932.22	Dy II	42	3935.84	Rh I
38	3929.26	Pr II	6	3932.23	Th II	3.5	3935.93	Ce II
13	3929.29	Nb I	65	3932.28	Er II	65	3935.97	Co I
11	3929.32	Dy II	20	3932.37	Tb I	13	3936.03	Dy II
110	3929.53	Zr I	14	3932.91	Th I	6	3936.06	Zr II
10	3929.54	Hf II	30	3932.97	Dy II	24	3936.11	Nd II
42	3929.58	Tm II	6	3932.97	Sm II	18	3936.22	La II
42	3929.67	Th II	11	3932.98	Gd II	4	3936.23	W I
6	3929.75	Tb I	13	3932.98	Pr	8	3936.28	V I
55	3929.85	Re I	9	3933.03	U II	7	3936.30	Dy II
9	3929.88	Pr	400	3933.38	Sc I	36 c	3936.44	Ho II
75	3929.88	Ti I	28	3933.55	Ru I	6	3936.45	Nb I
7	3929.89	Tb I	20	3933.58	Sm II	4	3936.55	Ta I
14 ch	3929.93	Ho II	4200	3933.67	Ca II	3.0	3936.69	Pr

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum
34	3936.71	Dy I
14	3936.90	Re I
13	3936.98	W I
8	3937.00	Nd I
260	3937.02	Er I
3.0	3937.03	Pr
10	3937.04	Th II
20	3937.06	Sm II
4	3937.15	Ce II
11	3937.16	Dy I
6	3937.17	Tb I
70	3937.44	Nb I
4	3937.53	V I
4	3937.57	Nd II
3.5	3937.63	Ce II
4	3937.63	W I
15	3937.64	Tb I
3.5	3937.81	Ce
9	3937.84	Ta I
3.5	3937.87	Ba I
11	3937.90	Ru I
8	3937.92	Th II
10	3937.96	Nb I
22	3938.00	Dy II
6	3938.07	Tb I
40	3938.09	Ce II
7	3938.11	Gd II
17	3938.15	Dy I
4	3938.20	V I
26	3938.31	Pr II
2.0	3938.43	Sm II
22	3938.59	Os I
170	3938.65	Er II
8 d	3938.69	Th I
	3938.73	Th II
24	3938.85	Ho I
30	3938.86	Nd II
7	3938.92	Er II
10	3938.97	Gd II
11	3939.04	Hf I
4	3939.33	V I
4	3939.36	Er II
4	3939.44	W
4	3939.52	Ce II
8	3939.52	Nd II
75 d	3939.52	Tb II
8	3939.57	Os I
3.5	3939.64	Sm II
4	3939.66	Ce II
10 c	3940.15	Pr II
55	3940.34	Ce II
24	3940.49	U
36 cw	3940.53	Ho II
7	3940.64	Ce II
3.0 h	3940.80	Sr I
1.6	3940.88	Fe I
7	3940.89	Co I
22	3940.97	Ce II
24	3941.21	Tb II
8 h	3941.23	Th
3.0	3941.25	V I
18	3941.27	Nb I
6	3941.48	Mo II
34	3941.49	Cr I
120	3941.51	Nd II
3.0	3941.51	Pr
6	3941.54	Re I
3.5	3941.56	Eu II
9	3941.62	Zr I
6	3941.65	Ru I
11	3941.73	Co I
42	3941.80	Gd I
85	3941.87	Sm II
7	3942.01	V I
8	3942.06	Ru I
3.5	3942.07	Th II
5	3942.12	Nd II
140	3942.15	Ce II
2.0 h	3942.21	Eu II
20	3942.21	Tb II
2.0	3942.24	Ta I
12	3942.26	Pr
1.4	3942.44	Fe I
44	3942.52	Dy II
20	3942.54	Ho I
14	3942.55	U II
12	3942.56	Er I
9	3942.62	Nd II
55	3942.63	Gd I
5	3942.64	Th II
50	3942.72	Rh I
190	3942.75	Ce II
18	3942.83	U
5	3942.92	Pr
4	3942.94	Eu II
10	3942.95	Tb I
22	3943.04	M Io
8	3943.08	Eu II
11	3943.14	Ce II
12	3943.21	Er II
25	3943.24	Gd I
42	3943.24	Sm II
5 c	3943.37	Pr
11	3943.39	Th II
4	3943.50	Ce II
3.5	3943.51	Mo I
20	3943.62	Gd I
12	3943.66	V I
54	3943.67	Nb I
9	3943.68	Tb I
6	3943.69	Th II
6	3943.75	Pr
90	3943.82	U I
55	3943.89	Ce II
450	3944.03	Al I
8	3944.05	Pr
18	3944.13	U II
6	3944.19	Ru I
28	3844.30	Dy I
260	3944.41	Er I
2.0	3944.59	Eu II
3.0	3944.62	Pr
850	3944.70	Dy II
11	3944.72	Re I
5	3944.84	Ce II
15	3944.88	Tb II
6	3944.90	Pr
6	3944.92	Ce II
7	3945.25	Mo I
9	3945.33	Co I
6	3945.42	Pr I
16	3945.51	Th II
130	3945.54	Gd I
70	3945.57	Ru I
10	3945.66	Pr II
2.0	3945.67	Eu II
6	3945.82	Th II
18	3945.91	Re I
16	3946.15	Th II
13	3946.27	Ir I
3.5	3946.31	Ru I
34	3946.51	Sm II
8	3946.68	Ce II
4	3946.81	Nd
60	3946.89	Tb II
34	3946.92	Dy II
16	3946.95	Pr
3.5	3947.17	Mo I
4	3947.25	Tb I
8	3947.33	Th I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
10	3947.53	Nb I	3.0	3950.76	Eu II	18	3953.16	W I
6	3947.61	Nd I	5	3950.80	Ce	55	3953.37	Gd I
65 c	3947.63	Pr II	7	3950.80	Hf I	5	3953.40	Nd II
90	3947.78	Ti I	9	3950.96	Er I	19	3953.52	Nd II
20	3947.84	Sm II	7	3950.99	Mo I	80 c	3953.52	Pr II
22	3947.97	Ce II	2.5	3951.10	Cr I	22	3953.58	U II
13	3947.98	W I	2.0	3951.11	Th II	24	3953.66	Ce II
5	3948.03	Th I	10	3951.14	Ho I	4	3953.68	La I
	3948.13	Th I	120	3951.16	Nd II	11	3953.93	Mo I
44	3948.07	Er II	3.0	3951.17	Fe I	11	3953.95	Ce II
50	3948.11	Sm II	6	3951.18	Pr	19	3954.05	Tb I
9	3948.32	Nd II	6	3951.21	Ru I	8	3954.20	Sm II
24	3948.35	Tb II	3.5	3951.33	Eu II	4	3954.29	Ta I
3.5	3948.40	Pt I	3.5	3951.33	Zr I	6	3954.41	Nd
22	3948.45	U I	7	3951.48	U	3.5	3954.43	Re I
380	3948.67	Ti I	20	3951.50	Er I	34	3954.56	Dy II
3.5	3948.78	Fe I	16	3951.52	Th II	40	3954.66	U II
1.2	3948.90	Ca I	7	3951.55	U II	2.0	3954.97	Sm
14 h	3948.96	Th II	15	3951.60	Y II	3.5	3955.00	Pr
11	3949.00	Ho I	8	3951.62	Ce	10 c	3955.05	Ho II
900	3949.10	La II	36	3951.83	Hf I	3.5	3955.09	Nd
2.0	3949.13	Eu II	3.0	3951.84	Pr	6 h	3955.09	Y I
5	3949.25	Gd II	6	3951.88	Tb I	8	3955.17	Th I
110	3949.28	Tm I	32	3951.89	Sm I	22	3955.31	W I
7 d	3949.33	Nb I	7	3951.95	Ir I	22	3955.36	Ce
	3949.46	Nb II	11	3951.97	V II	4	3955.37	Os I
13	3949.39	Ce II	28	3952.00	Gd II	18	3955.38	U
6	3949.42	Ru I	6	3952.02	Pr	5	3955.42	Pr
80 c	3949.44	Pr II	7	3952.11	Ce II	6	3955.49	Mo I
6	3949.51	Tb II	7	3952.16	Ta I	4	3955.65	Tb I
4	3949.60	Eu I	48	3952.20	Nd II	11	3955.68	Nb I
9	3949.78	Os I	4	3952.27	Sc	65	3955.73	Ho I
7	3949.82	Ce I	2.0	3952.33	Co I	4	3955.75	Eu I
3.5	3949.85	Sm I	4	3952.36	Pr	3.5	3955.89	Th
6	3949.94	Nb I	7	3952.37	Nb II	11	3955.92	Ce II
3.5	3949.96	Fe I	3.5	3952.40	Cr I	7	3955.95	Nd II
11	3950.04	Ru I	13	3952.52	W I	16	3956.06	Ce II
19	3950.14	Tb I	220	3952.54	Ce II	6	3956.18	Tb II
42	3950.21	Ru I	2.0	3952.61	Fe I	7	3956.24	Dy I
8	3950.23	V I	3.5	3952.62	Ir I	70	3956.28	Ce II
440	3950.36	Y II	28	3952.68	Ru I	380	3956.34	Ti I
14	3950.39	Th II	3.5	3952.76	Th I	26	3956.43	Er I
44	3950.40	Dy II	5	3952.77	Os I	3.5	3956.46	Fe
14	3950.41	Ru I	5	3952.84	Mn I	5 hc	3956.52	Pr
13	3950.42	Ce II	19	3952.87	Nd II	7	3956.57	Ta I
4	3950.42	Nd	13	3952.90	W I	28 d	3956.59	Th II
19	3950.44	Tb I	16	3952.92	Co I		3956.68	Th II
24	3950.56	Ho I	10	3953.08	Nb I	7	3956.68	Fe I
7	3950.64	Re I	7	3953.13	Dy II	34	3956.76	Pr II
4 c	3950.66	Pr	3.0	3953.16	Cr I	13 d	3956.77	Ce I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
	3956.90 Ce II		11	3959.80 Ce II		7	3963.80 Dy II	
3.5	3956.79 Zr		4	3959.91 Er II		7 h	3963.80 Zr I	
2.0	3956.82 Ta I		17	3960.11 Gd I		16	3963.90 Nd II	
3.5	3957.05 Ca I		3.0 h	3960.12 Tb II		3	3963.99 Mo I	
5	3957.15 Ce II		6	3960.30 Tb I		11	3964.18 Ce	
	3957.21 Ce I		5	3960.33 Th II		26	3964.22 U I	
4	3957.16 Th ThO		7	3960.38 Ce II		50	3964.26 Pr II	
16	3957.35 Tb I		8	3960.51 Os I		80	3964.27 Ti I	
13	3957.39 Ho I		8 c	3960.60 Pr		28	3964.50 Ce II	
4	3957.42 Tm II		9	3960.70 Tb I		7	3964.52 Er I	
14	3957.45 Nd II		55	3960.91 Ce II		4	3964.54 Rh	
3.5	3957.45 Ru I		3.5	3960.98 Nb I		3.5	3964.66 Nb I	
3.5	3957.52 Sm II		2.0	3961.00 Co I		18	3964.67 U	
110	3957.67 Gd II		18	3961.02 Os I		3.5 d	3964.74 Th I	
5	3957.68 Pr		28	3961.04 Re I			3964.87 Th II	
65	3957.79 Dy II		13	3961.21 Er I		3.0	3964.81 Re I	
2.5	3957.92 Eu II		5	3961.28 Pr		140 c	3964.83 Pr II	
9	3957.94 Co I		900	3961.53 Al I		8	3964.90 Eu II	
11	3957.97 Ce II		13	3961.80 Sm II		42	3964.90 Ru I	
26	3957.97 Tb II		11	3962.09 Ce II		7	3964.95 Hf II	
35	3958.00 Nd II		5	3962.10 Gd II		9	3964.96 Os I	
110	3958.10 Tm II		6	3962.13 Sm I		12	3964.96 U	
6	3958.19 Pr		30	3962.21 Nd II		9	3964.99 W I	
440	3958.21 Ti I		6	3962.24 Sm II		7	3965.04 Gd I	
85	3958.22 Zr II		9	3962.33 W I		16	3965.10 Tb I	
8	3958.24 Rh I		4	3962.42 Th I		18	3965.14 W I	
16	3958.27 Ce II		42	3962.45 Pr II		100 c	3965.26 Pr II	
32 d	3958.36 Tb II		35 c	3962.48 Re I		4	3965.62 Pr	
6	3958.50 Pr		30	3962.58 Dy I		26	3965.69 Nb I	
3.5	3958.60 Mo I		3	3962.61 Tb I		3.5	3965.76 Mo I	
160	3958.64 Pd I		3.5	3962.78 Ir I		16	3965.95 Tb II	
10	3958.68 Gd I		14	3962.79 U II		42	3966.04 Sm II	
8	3958.72 Sm II		80	3962.85 Ti I		4	3966.07 Fe I	
320	3958.86 Rh I		100	3963.00 Sm II		4	3966.09 Ir I	
16	3958.87 Ce		80	3963.12 Nd II		95 d	3966.09 Nb I	
8	3958.88 W I		14 c	3963.15 Pr			3966.25 Nb I	
9	3959.20 U		9	3963.16 Dy		55	3966.28 Gd I	
8	3959.30 Th I		3.5	3963.22 Th II		6	3966.34 Sm II	
7	3959.35 Dy II		6	3963.27 Re I		22	3966.35 Er I	
7	3959.36 Nb I		13	3963.29 Ho II		10	3966.36 Pt I	
17	3959.41 Pr		9	3963.36 Er II		9	3966.39 Dy I	
	3959.52 Pr		7	3963.37 Ce II		18	3966.40 U II	
70	3959.44 Gd II		2.0	3963.48 Th II		50 c	3966.57 Pr II	
	3959.52 Gd II		3	3963.53 Mo I		44	3966.57 U II	
26 c	3959.51 Ho II		2.0	3963.61 Eu I		10	3966.59 Eu II	
25	3959.53 Sm II		90	3963.63 Os I		3.0	3966.63 Fe I	
13	3959.62 Ce II		7	3963.63 V I		44	3966.66 Zr I	
55	3959.68 Ho I		20	3963.66 Gd II		55	3967.05 Ce II	
3.0	3959.73 Ta I		160	3963.69 Cr I		7	3967.06 Nd II	
4	3959.78 Pr		4	3963.71 Pr		14	3967.13 Pr	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
11	3967.18	Ce II	17 h	3970.80	W I	5	3974.19	Ce II
3.0	3967.18	Eu I	13	3971.06	Gd II	4	3974.22	Th II
9	3967.22	Tb I	13	3971.15	Dy I	16	3974.29	Tb II
13	3967.33	Ho I	44	3971.16	Pr II	8 c	3974.37	Pr
7	3967.39	Re I	7	3971.26	Cr I	13	3974.45	Sm II
28	3967.39	Th I	2.5	3971.33	Fe I	8	3974.50	Ru I
3.0	3967.42	Fe I	100	3971.40	Sm II	12	3974.55	Ho I
9	3967.48	U	32	3971.68	Ce II	42	3974.66	Sm I
26	3967.50	Dy I	28	3971.69	Pr II	16	3974.68	Tb I
8	3967.53	Ce II	42	3971.75	Gd II	110	3974.72	Er II
20	3967.66	Tb I	20	3971.79	Tb I	4	3974.73	Co I
32	3967.68	Sm II	22	3971.85	Nb I	28	3974.81	Gd I
9	3967.75	Nd II		3971.93	Nb I	28	3974.86	Pr II
14	3968.01	Hf I	8	3971.88	Ce II	9 h	3974.98	U
4	3968.09	V II	2000 cw	3971.96	Eu II	19	3975.07	Ce II
14	3968.16	Pr	16	3972.06	Tb II	11	3975.11	Gd II
55	3968.26	Gd II	19	3972.07	Ce II	9	3975.20	Nd
90	3968.26	Zr I	14	3972.15	Th I	11	3975.22	Sm II
1100	3968.42	Dy II	55 c	3972.16	Pr II	18	3975.29	Zr I
50	3968.46	Lu I	8	3972.17	Gd II	32	3975.31	Rh I
2200	3968.47	Ca II	4	3972.17	Ni I	10 h	3975.44	Os I
14	3968.59	W I	3.5	3972.30	Zr I	9	3975.46	W I
7	3968.75	Mo I	7	3972.39	Dy I	3.5	3975.65	Re I
10	3968.88	Nd	18	3972.52	Nb I	24	3975.88	Ho I
70	3969.00	Gd I	3.5	3972.53	Co I	4	3975.89	Mn I
5	3969.00	Th II	5	3972.63	Th I	5	3975.89	W I
9	3969.02	U	11	3972.64	Ho II	6	3975.96	Mo I
10	3969.06	Cr I	36	3972.71	Gd I	7	3976.09	Nd I
4.5	3969.12	Co I	5	3973.03	Ce	65	3976.27	Sm II
9	3969.20	W I	220	3973.04	Er I	5	3976.29	Pr
55	3969.26	Fe I	5	3973.12	Pr	65	3976.31	Ir I
6	3969.26	Sr I	4	3973.15	Co I	15	3976.42	Th II
25	3969.29	Gd II	11	3973.20	Th I	70	3976.43	Sm II
13	3969.45	Er II	65	3973.30	Nd II	7	3976.56	Pr
7	3969.67	Nd	10	3973.39	Zr I	130	3976.66	Cr I
13	3969.67	Os I	18	3973.48	Hf I	13	3976.67	Nb I
130	3969.75	Cr I	60	3973.50	Zr I	7	3976.68	Tm I
3.0	3969.79	Ru I	12	3973.56	Ni I	22	3976.74	Er I
5	3969.94	Tb I	260	3973.60	Er I	5	3976.78	Ce II
11	3970.04	Ce II	11	3973.62	Nb I	9	3976.83	Pr
3.0	3970.04	Sr I	8	3973.64	V II	200 d	3976.84	Tb II
13 bl	3970.05	Hf HfO	44	3973.69	Nd II	44	3976.85	Nd II
5	3970.07	Pr	14	3973.71	Ca I	44 c	3976.93	Ho I
22	3970.10	Ta I	14	3973.77	Mo I	19	3976.97	Ho II
6	3970.18	Gd I	10	3973.83	Ho II	65	3977.03	Er I
16 d	3970.19	Tb II	13	3973.87	Dy I	5	3977.08	Mn I
4	3970.42	Ce II	5 c	3973.90	Pr	1.2	3977.18	Co I
50	3970.53	Sm II	11	3973.93	Mo I	65	3977.23	Os I
12	3970.64	Ce II	55	3973.98	Gd II	6	3977.33	Nd
7	3970.65	Nb I	6	3974.00	Ce I	6	3977.34	Zr I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
5	3977.42 Pr		8	3980.88 Pr		7	3984.18 U	
14	3977.48 Zr	I	3.5	3980.88 Sm	II	65	3984.24 Dy	II
2.5	3977.53 Ce	II	3.5	3980.98 Nd		4	3984.25 Re	I
3.5 h	3977.71 Pr		2.0	3981.01 Ta	II	8	3984.27 Pr	
6	3977.74 Fe	I	14	3981.11 Th	II	5	3984.33 Ti	I
11	3977.77 Ce	II	24	3981.16 Tb	II	16	3984.34 Cr	I
6	3977.90 Mo	I	6 h	3981.20 Pr		4	3984.34 V	I
11	3977.94 Nb	I	7	3981.23 Cr	I	20	3984.40 Rh	I
3.5	3977.99 Nd		8	3981.24 Nd	II	7	3984.60 V	I
3.5	3978.25 Zr	I	9	3981.37 Dy	I	55	3984.68 Ce	II
4	3978.42 Eu	I	18 h	3981.60 Zr	I	7	3984.70 Dy	II
55	3978.44 Ru	I	400	3981.76 Ti	I	14	3984.75 Zr	I
220	3978.57 Dy	II	2.0	3981.77 Fe	I	3.0	3984.81 Nb	I
55	3978.65 Ce	II	4	3981.82 Th	I	14	3984.84 Tb	II
6	3978.66 Co	I	170	3981.89 Tb	II	80	3984.86 Ru	I
7	3978.68 Cr	I	3.0	3981.90 Ce	II	1.8	3984.98 Ta	I
9	3978.74 Zr	I	110	3981.92 Dy	II	14	3985.08 Tb	II
11	3978.75 Nb	I	9	3981.95 Ta	I	6	3985.18 Nb	I
14	3978.80 U		15	3982.04 Ho	II	11	3985.24 Mn	I
4	3979.03 Nd		7	3982.05 Mo	I	3.0	3985.25 Ti	I
4	3979.04 Th		3.5	3982.06 Nb	I	5	3985.59 Ti	I
4	3979.14 Er	II	190 c	3982.06 Pr	II	8 c	3985.66 Pr	
4	3979.14 V	I	9	3982.16 Zr	I	24 cw	3985.71 Ho	II
65	3979.20 Sm	II	8	3982.17 Ce	I	85	3985.80 U	II
3.5	3979.22 Mo	I	90	3982.33 Er	I	10	3986.00 Sm	II
7	3979.28 Ta	I	19	3982.36 Nd	II	6	3986.17 Pr	
14	3979.29 W	I	48	3982.48 Ti	I	13	3986.20 Mo	I
70	3979.33 Gd	I	9 h	3982.50 Pr	II	2.0	3986.21 Sm	II
4	3979.36 Os	I	10	3982.58 Mn	I	28	3986.25 Nd	II
7	3979.37 Nb	I	3.5	3982.60 Mo	I	24	3986.35 Tb	II
7	3979.40 Hf	II	360	3982.60 Y	II	4	3986.40 Ce	II
55	3979.42 Ru	I	4	3982.87 W	I	3.5 h	3986.60 Eu	I
4	3979.42 V	I	40	3982.89 Ce	II	50	3986.68 Sm	II
22	3979.47 Dy	II	10	3982.96 W	I	6	3986.80 Zr	I
44	3979.49 Nd	II	14	3983.01 Gd	II	14	3986.83 Mn	I
5	3979.52 Co	I	50	3983.14 Sm	II	10	3986.90 Sm	II
2.0	3979.63 Eu	II	9	3983.15 Er	II	7	3987.04 Dy	II
3.5	3979.69 Pr		22	3983.29 Ce	II	11	3987.10 Mn	I
3.5	3979.80 Cr	I	28	3983.29 W	I	2.0	3987.12 Co	I
11	3980.09 Th	I	5	3983.41 Nd	II	42	3987.21 Gd	II
13	3980.17 Er	II	4	3983.58 Nd		6	3987.22 Th	I
7	3980.20 Mo	I	8 h	3983.58 Pr		3.5	3987.25 Nd	
8	3980.23 Pr		130	3983.67 Dy	II	11	3987.37 Pr	
4	3980.48 Nb	I	2.0	3983.82 Ta	I	25	3987.43 Sm	II
4	3980.52 V	I	28	3983.85 Tb	II	4	3987.50 Y	I
13	3980.61 Er	I	80	3983.91 Cr	I	22	3987.53 Er	I
14	3980.64 W	I	3.5	3983.91 Re	I	65	3987.66 Er	I
4	3980.75 Th	II	17	3983.91 U	II	14	3987.67 Tb	I
9 h	3980.80 U	I	4	3983.96 Fe	I	2.5	3987.80 Ru	I
40	3980.88 Ce	II	24	3984.05 Tb	II	3.0	3987.81 Nd	II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
44	3987.84	Gd I	9	3991.22	W I	38	3994.55	Th
1900	3987.98	Yb I	4	3991.26	Pr	8	3994.57	Ce II
14	3988.01	Th II	44	3991.33	Dy II	3.0	3994.70	Ti I
8	3988.02	Pr	5	3991.38	Lu I	65	3994.72	Nd II
11	3988.16	Nb I	3.5	3991.39	Mo I	140	3994.83	Pr II
9	3988.18	Os I	3.5	3991.49	Os I	4	3994.87	Er II
2.5	3988.24	Eu II	3.0	3991.54	Co I	4	3994.93	Os I
440	3988.52	La II	7 d	3991.58	Tb I	17	3994.98	U
4	3988.60	Th II	13	3991.67	Cr I	8	3995.15	Tb I
3.5	3988.62	Os I	11	3991.68	Nb I	5	3995.26	Er II
6	3988.64	U	3.0	3991.69	Co I	8	3995.26	Nd II
9	3988.68	Zr I	8	3991.73	Th I	260	3995.31	Co I
9	3988.70	Ta I	60	3991.74	Nd II	2.5	3995.42	Ce II
4	3988.82	Nd II	3.5	3991.85	Mo I	6	3995.59	Sm II
7	3988.83	V I	20	3991.89	Pr II	32	3995.59	Tm II
5	3988.85	Th II	50	3992.12	Ir I	20	3995.61	Rh I
14	3988.89	U II	5	3992.13	Ce II	3.0	3995.66	Ba I
10	3988.90	Dy I	5	3992.16	Nd	360	3995.75	La II
4	3989.06	Sc II	30	3992.18	Pr II	7 d	3995.80	Tb II
9	3989.25	Gd II	5	3992.28	Nd	24	3995.85	Pr
7	3989.29	Zr I	4	3992.28	Th II	14	3995.97	U II
26	3989.44	Ce II	50	3992.39	Ce II	3.5	3995.98	Eu II
14	3989.50	Zr I	28	3992.54	U II	26	3995.98	Ru I
7	3989.54	Tb I	10	3992.60	Nd II	7	3996.01	Dy I
120 c	3989.72	Pr II	30	3992.69	Gd I	18	3996.06	Th II
2.5	3989.76	Ce	18	3992.72	Ho I	32	3996.15	Rh I
480	3989.76	Ti I	8	3992.75	W I	22	3996.17	Ta I
13	3989.99	Cr I	20	3992.80	V I	65	3996.32	Gd II
100	3990.00	Sm II	16	3992.84	Cr I	5 d	3996.36	Ce
	3990.02	Sm I	26	3992.91	Ce II		3996.49	Ce II
85	3990.10	Nd II	6 h	3992.92	Pr	2.5	3996.51	Ru I
13	3990.11	Ce II	4 c	3993.19	Pr	130	3996.52	Tm II
5	3990.22	Tb I	20	3993.21	Gd II	2.0	3996.57	Pt I
3.0	3990.30	Co I	50	3993.31	Sm II	500	3996.61	Sc I
6	3990.34	Dy II	18	3993.40	Ba I	130	3996.70	Dy II
4	3990.40	Ta I	5	3993.53	Ru I	3.5	3996.80	Os I
34	3990.42	U II	17 d	3993.54	Tb I	50 c	3997.05	Pr II
8	3990.49	Th I	14	3993.60	Dy I	9	3997.09	U I
42	3990.57	V I	24	3993.73	Ho II	4	3997.12	V II
20	3990.63	Tb I	65	3993.82	Ce II	5	3997.13	W I
3.0	3990.67	Nb I	5	3993.90	W I	9	3997.18	Ho II
5	3990.69	Ce II	2.0	3993.93	Eu II	8	3997.40	Fe I
55	3990.89	Yb I	3.5	3993.93	Mo I	14	3997.43	Tb II
10	3991.02	Sm I	3.5	3993.97	Cr I	4	3997.44	Nd II
3.5	3991.03	Re I	8	3994.01	Pr	4	3997.47	Th II
80	3991.12	Cr I	60	3994.16	Gd II	3.5	3997.48	Ce
70	3991.13	Zr II	9	3994.29	U	10	3997.72	Ce II
18	3991.16	Er I	3.0	3994.43	Nb I	30	3997.76	Gd II
5 d	3991.22	Ce	7	3994.53	Dy I	4	3997.78	Nd
	3991.33	Ce II	2.0	3994.54	Co I	11	3997.87	Th II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
42	3997.91 Co I		9 c	4001.32 Ho II		32	4005.21 U I	
10	3997.93 Nd		9	4001.37 W I		40	4005.25 Fe I	
20	3997.96 Pr II		13	4001.44 Cr I		8	4005.40 W I	
3.0	3998.06 Fe I		6	4001.47 Pr		10	4005.53 Th II	
9	3998.08 Dy II		16	4001.56 Ce II		180	4005.57 Tb II	
5	3998.16 Nd		10	4001.73 Ce II		26	4005.64 Ce II	
5	3998.16 W I		4	4001.73 Th II		13	4005.64 Ru I	
26	3998.24 U		6	4001.96 Gd II		14	4005.70 U	
15	3998.29 Ho I		32 d	4002.19 Tb II		13	4005.71 V II	
3.5	3998.29 Mo I		3.0	4002.26 Nb I		34	4005.86 Dy I	
13	3998.35 Sm I		9	4002.34 U		4 d	4005.93 Nb I	
14	3998.40 Tb II		6	4002.49 Ti I		10	4005.97 Tb II	
650	3998.64 Ti I		7	4002.55 Zr I		3.0	4005.97 Ti I	
10	3998.69 Nd		18 cw	4002.59 Ho II		7	4006.05 Mo I	
34	3998.73 V I		90	4002.59 Tb II		26	4006.09 Dy I	
8	3998.76 W I		13	4002.81 Ce II		7	4006.38 Th II	
10	3998.90 Tb I		8	4002.97 Ce II		8	4006.60 Ru I	
5	3998.93 Os I		13	4003.10 Zr I		13	4006.60 Sm II	
70	3998.97 Zr II		8	4003.11 Th II		13	4006.70 Pr II	
13 d	3999.16 Er II		8	4003.17 Ce II		6	4006.82 Sm II	
15	3999.18 Nb I		9	4003.20 U		20	4006.84 Ta I	
9	3999.18 U I		17	4003.31 Th II		10	4006.96 Gd I	
28	3999.19 Pr II		24	4003.39 Ho I		18	4007.02 Th II	
200	3999.24 Ce II		19	4003.46 Sm II		3.5	4007.23 Ta I	
6	3999.24 Tb II		13	4003.48 Os I		3.0	4007.36 Yb I	
11	3999.28 Ta I		7	4003.70 Ta I		24	4007.43 Nd II	
6	3999.36 Ti I		4	4003.71 Eu II		5	4007.45 Ce II	
32	3999.40 Tb II		6	4003.72 Sm II		32	4007.48 Sm II	
42	3999.58 Ho I		4	4003.75 Pr		5	4007.54 Ru I	
14	4000.01 Tb II		65	4003.77 Ce II		15	4007.59 Ce II	
6	4000.18 Gd I		10	4003.78 Tb II		18	4007.60 Zr I	
55 c	4000.19 Pr II		6	4003.81 Ti I		8	4007.75 Dy II	
4	4000.28 Th		6	4003.85 Gd II		6	4007.78 Pr	
6	4000.39 Mo I		6	4003.91 Tb II		1100	4007.97 Er I	
650	4000.48 Dy II		32	4004.02 Nd II		3.0	4008.05 Mo I	
10	4000.48 Pr II		9	4004.02 Os I		6	4008.06 Ti I	
11	4000.50 Mo I		4	4004.05 Ce		10	4008.10 Sm II	
24	4000.50 Nd II		26	4004.06 U II		18	4008.19 Er II	
4	4000.60 Nb II		18	4004.07 Er I		16	4008.21 Th I	
1.2	4000.68 Ce		6	4004.26 Nd		8	4008.27 Ru I	
9 h	4000.69 W I		3.5	4004.26 Sm II		14	4008.28 Nb I	
1.2	4000.80 Ce II		7	4004.40 Zr I		30	4008.33 Gd I	
8 c	4000.91 Pr		7	4004.52 Tb II		10	4008.33 Sm II	
8	4001.06 Ce II		7	4004.58 Ce II		3	4008.66 Ce II	
8	4001.06 Th I		65	4004.71 Pr II		170	4008.71 Pr II	
3.5	4001.09 Zr I		7 h	4004.87 Zr I		5	4008.75 Nd	
8	4001.13 Nb I		10	4004.93 Re I		950	4008.75 W I	
9 d	4001.25 U		24	4004.94 Gd II		28	4008.91 Gd II	
44	4001.26 Gd II		4	4005.09 Th I		80	4008.93 Ti I	
17	4001.28 Tb I		13	4005.16 Os I		16	4009.05 Th I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
4	4009.06	Ce II	14	4013.43	Gd I	11	4018.38	Zr II
22	4009.16	Er II	10	4013.43	Pr	3.5	4018.40	Re I
9	4009.17	U II	12	4013.50	Ho I	10	4018.42	Tb I
10	4009.22	Gd II	8	4013.50	Ru I	22	4018.81	Nd II
8	4009.24	Pr	15	4013.58	Ti I	22	4018.99	U II
14	4009.26	Tb I	44	4013.80	Dy I	14	4019.04	Ce II
11	4009.37	Mo I	28	4013.80	Gd II	300	4019.13	Th II
14	4009.56	Tb II	3.0	4013.94	Co I	34	4019.14	Tb II
16	4009.66	Ti I	8	4013.95	Gd II	24	4019.23	W I
14	4009.71	Nb I	6	4014.16	U	1.0	4019.30	Co I
3.5	4009.72	Fe I	36	4014.20	Ho II	40	4019.64	Pb I
4	4009.72	Th I	8	4014.35	Pr	28	4019.73	Gd I
	4009.81	Th I	48	4014.49	Sc II	8	4019.77	Th ThO
12	4009.77	Er I	4	4014.51	Th II	7	4019.79	Nd II
6	4009.97	Pr	4	4014.53	Fe I	8	4019.84	Sm II
28	4010.06	Tb I	2.5	4014.67	Cr I	10	4019.90	Ce II
10	4010.08	Dy II	44	4014.72	Dy II	19	4019.98	Sm II
10	4010.14	Ce II	65	4014.90	Ce II	20	4020.03	Ir I
5	4010.38	W I	3.0	4014.93	Nb I	5	4020.05	Nd II
6	4010.45	Nd II	6 h	4015.04	Os I	3.0	4020.24	Nb I
55	4010.64	Pr II	17	4015.18	Dy II	1800	4020.40	Sc I
14	4010.85	Tb I	14	4015.22	Gd I	50	4020.47	Tb II
9	4011.09	Nd II	60	4015.22	W I	240	4020.52	Er I
44	4011.32	Dy II	6	4015.38	Ti I	60	4020.87	Nd II
8	4011.45	U	18	4015.39	La I	13	4020.88	Dy II
7	4011.56	Ce II	65	4015.39	Pr II	15	4020.90	Co I
4	4011.59	Th I	4	4015.56	Nd	55	4020.99	Pr II
12	4011.69	Eu II	19	4015.58	Gd I	5	4021.00	Ru I
6	4011.73	Sm II	28	4015.61	Er II	12	4021.02	Mo I
8	4011.75	Th I	4	4015.77	Sm II	60	4021.34	Nd II
6	4011.97	Mo I	18	4015.88	Ce II	36	4021.55	Er I
7	4012.06	Nb I	4	4016.08	Nb I	60	4021.78	Nd II
7	4012.11	Ta I	3.0	4016.28	Ti I	12	4021.83	Ti I
220	4012.25	Nd II	9	4016.36	Er I	4	4021.87	Fe I
18	4012.25	Zr I	19 h	4016.53	W I	9	4021.96	Er II
6	4012.26	Re I	2.5	4016.75	Pr II	15	4022.08	Th
190	4012.39	Ce II	14	4016.98	Zr I	14	4022.12	W I
6	4012.39	Ti II	28	4017.25	Gd I	140	4022.16	Ru I
10	4012.47	Cr II	4	4017.38	Mo I	8	4022.20	Pr II
20	4012.50	Th I	12	4017.56	Nb I	7	4022.26	Cr I
90	4012.58	Er I	10	4017.58	Eu II	17	4022.27	Ce II
32	4012.70	Nd II	10	4017.60	Ce II	28	4022.33	Gd II
70	4012.75	Tb II	40	4017.71	Gd I	3.0	4022.39	Nb I
14	4012.86	Tb II	42	4017.72	U II	2.0 h	4022.63	Cu I
4	4012.98	Er II	10 h	4017.77	Ti I	6	4022.73	Sm II
7	4013.19	Ta I	7	4017.85	Tb II	42	4022.74	Pr II
8	4013.23	Pr	18 c	4018.09	Ho II	18 c	4022.76	Ho II
8 h	4013.25	Nd II	110	4018.10	Mn I	20	4022.89	Tb I
20	4013.27	Nb I	4	4018.10	Th I	14	4022.96	Re I
30	4013.27	Tb I	14	4018.26	Os I	70	4023.03	Nd II

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
100	4023.14 Gd I		36	4027.21 Ho I		9	4031.83 V I	
16	4023.14 Nb I		7	4027.31 Nb I		14	4032.20 Ru I	
10	4023.14 Rh I		3.5	4027.48 Ti I		16	4032.27 Hf I	
4	4023.17 V I		20	4027.61 Gd I		80	4032.34 Tb I	
60	4023.23 Sm II		12	4027.69 Ce		3.0	4032.38 Sr I	
10	4023.31 Re I		34	4027.79 Dy II		42	4032.44 Dy II	
75	4023.35 Gd I		7	4027.98 Nb I		8	4032.46 Th II	
2.5	4023.37 Ce		100	4028.15 Gd I		20	4032.49 Pr II	
9	4023.39 V II		16 d	4028.31 Tb II		4	4032.50 Mo I	
1.0	4023.40 Co I		42 d	4028.32 Dy II		110	4032.52 Nb I	
9	4023.59 La II			4028.42 Dy I		8	4032.60 Th II	
1800	4023.69 Sc I		3.5	4028.34 Ti II		13 d	4032.72 Tb I	
30	4023.70 Dy I		60	4028.41 Ce II		13	4032.84 Dy I	
55	4023.83 Ru I		6	4028.53 Re I		8	4032.92 Os I	
18 c	4023.94 Ho II		8	4028.59 Tb I		13	4032.97 Pr II	
36	4023.98 Zr I		6	4028.65 Mo I		1000	4032.98 Ga I	
16	4024.09 Mo I		20	4028.79 W I		10	4032.98 Sm II	
17 d	4024.10 Tb II		30	4028.86 Ho I		190	4033.06 Tb II	
16	4024.23 Tm I		22	4028.95 Zr I		1400	4033.07 Mn I	
10	4024.35 Ce II		20	4029.04 Pr II		9	4033.07 Ta I	
10	4024.41 Pr		3.0	4029.22 Nb I		3.0	4033.20 Nb I	
11	4024.44 Zr II		5 h	4029.32 Os I		22	4033.31 Re I	
20	4024.45 Dy II		11 c	4029.63 Re I		2.0	4033.38 Ta I	
60	4024.49 Ce II		36	4029.68 Zr II		12	4033.43 U II	
100	4024.57 Ti I		32 c	4029.73 Pr		65	4033.49 Gd I	
20	4024.78 Nd II		15	4029.94 Ta I		7	4033.50 Nd	
34	4024.79 Tb I		44	4030.04 Zr I		4	4033.55 Sb I	
20	4024.87 Dy I		4	4030.16 Ce II		4	4033.63 Mo I	
70	4024.92 Zr I		18	4030.34 Ce II		1.8	4033.63 Ta I	
6	4025.01 Cr I		4 h	4030.35 Nb I		34	4033.67 Dy II	
3.5	4025.14 Ti II		13	4030.38 Sr I		14	4033.73 U	
17	4025.15 Ce II		6	4030.46 Pr		38	4033.76 Ir I	
6	4025.19 Pr		24	4030.47 Nd II		85	4033.86 Pr II	
12	4025.39 Ho I		16 h	4030.51 Ti I		6	4033.90 Nd	
32	4025.55 Pr II		20	4030.67 Sc I		3.5	4033.91 Ti I	
15	4025.66 Th II		7	4030.68 Cr I		4	4034.01 Nd II	
16	4025.73 Tb II		2000	4030.76 Mn I		3.5	4034.09 Zr II	
25	4025.88 La II		18	4030.84 Th I		9	4034.23 Sc I	
6	4026.02 U II		80	4030.88 Gd I		10	4034.25 Th II	
12	4026.16 Th II		8	4031.00 Ru I		20	4034.30 Pr II	
10	4026.17 Cr I		7	4031.08 Dy I		800	4034.49 Mn I	
11	4026.44 Mn I		13	4031.09 Pr		16	4034.50 U I	
16 h	4026.54 Ti I		12	4031.31 U		6	4034.76 Tm II	
20	4026.84 Pr II		60	4031.34 Ce II		5	4034.90 Th	
20	4026.94 Ta I		13	4031.39 Sc I			4034.93 Th I	
10	4027.01 Th I		48	4031.66 Tb II		2.5	4034.91 Ti I	
3.0	4027.04 Co I		280	4031.69 La II		7	4035.10 Nb I	
5	4027.05 Ce II		65 c	4031.76 Pr II		50	4035.11 Sm II	
7	4027.10 Cr I		20 c	4031.80 Ho I		5	4035.36 W I	
90	4027.20 Zr I		70	4031.82 Nd II		32	4035.40 Gd I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
4 h	4035.55 Co I		42	4039.36 Pr II		5	4043.05 Nd	
12	4035.63 V II		14	4039.48 Tb I		5	4043.12 Th II	
110	4035.73 Mn I		10	4039.49 Gd II		9	4043.16 Nb I	
9	4035.83 Ti I		26	4039.53 Nb I		8	4043.40 Th I	
7	4035.89 Ta I		6	4039.61 Er I		55	4043.58 Zr I	
36	4035.89 Zr I		3.5	4039.63 Ta I		24	4043.59 Nd II	
7	4035.93 Nb I		16	4039.67 Gd II		4	4043.67 Tb II	
18	4036.05 Th I		16	4039.78 U		38	4043.71 Gd I	
15	4036.12 Er I		95	4039.83 Y I		20	4043.80 Sc I	
32	4036.24 Tb I		8	4039.86 Th I		5	4043.89 W I	
34	4036.34 Dy II		15	4039.86 W I		4	4044.02 Gd I	
4	4036.46 Tb II		6	4039.89 Ce II		17	4044.10 Nb I	
6 c	4036.54 Pr		14	4040.08 Ir I		16	4044.11 Sm II	
17	4036.56 Th II		14	4040.11 Tb I		32	4044.14 K I	
4	4036.59 La II		3.5	4040.24 Zr II		15 h	4044.29 W I	
24	4036.84 Gd I		3.0 h	4040.32 Ti I		5	4044.35 Nd II	
20	4036.86 W I		12	4040.41 Tb II		8	4044.39 Hf I	
12	4037.10 Sm II		7 h	4040.47 Nb I		38	4044.42 U	
14	4037.21 La I		3.0	4040.48 Ru I		28	4044.47 Tm I	
6	4037.22 Pr		5	4040.59 W I		44	4044.56 Zr I	
4	4037.30 Mo I		150	4040.76 Ce II		13	4044.71 Nb I	
130	4037.33 Gd II		180	4040.80 Nd II		120	4044.82 Pr II	
4	4037.39 Ce II		300	4040.81 Ho I		150	4045.01 Gd I	
11	4037.49 Re I		13	4040.87 Ta I		38	4045.05 Sm II	
24	4037.62 Ho I		4	4040.94 Au I		16 d	4045.13 Mn I	
24	4037.67 Ce II		12	4041.06 Nd II			4045.21 Mn I	
14	4037.69 Er I		9	4041.06 Ta I		12	4045.15 Gd II	
3.5	4037.74 Ru I		3.0	4041.12 Mo I		22 d	4045.21 Ce II	
8	4037.78 Mo I		17	4041.20 Th II			4045.32 Ce II	
9	4037.84 Os I		8	4041.27 Ce II		6	4045.36 Tb I	
65	4037.90 Gd II		420	4041.36 Mn I		16	4045.39 Co I	
12	4038.08 Mo I		9	4041.64 Zr I		600 c	4045.44 Ho II	
10	4038.10 Sm II		40	4041.68 Sm II		100	4045.60 W I	
16	4038.12 Nd II		6	4041.85 Tb I		3.5	4045.61 Th II	
4 h	4038.18 Nb I		25	4041.92 Os I		36	4045.61 Zr II	
20	4038.19 Pr II		26	4041.98 Dy II		20	4045.71 Pr	
12	4038.25 Ce II		4	4042.14 Ce II		16	4045.76 Ru I	
65	4038.47 Pr II		22	4042.22 Zr I		300	4045.82 Fe I	
20	4038.51 Dy II		9	4042.34 Tb II		1000	4045.99 Dy I	
5	4038.64 Os I		5	4042.51 Nd		30	4046.16 Sm II	
4	4038.73 Mn I		9	4042.57 Nb I		44	4046.34 Ce II	
15	4038.84 Dy I		65	4042.58 Ce II		18	4046.48 Sc I	
19	4038.86 Tb I		9	4042.64 V I		180	4046.56 Hg I	
24 c	4038.87 Ho II		50	4042.72 Sm II		20	4046.64 Pr II	
5	4038.90 Pr		6	4042.76 Gd II		10	4046.70 W I	
16	4039.10 Cr I		75	4042.76 U I		25	4046.84 Gd II	
9	4039.10 Nb I		12	4042.87 Mo I		80	4046.97 Er I	
8	4039.19 Eu I		60	4042.90 Sm II		25	4047.09 Gd I	
28	4039.21 Ru I		300	4042.91 La II		30	4047.10 Pr II	
3	4039.21 Tb II		18	4043.03 Er II		14	4047.14 Tb I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
50	4047.16 Sm II		18	4050.33 Zr II		6	4055.16 Ce II	
16	4047.20 K I		25	4050.37 Gd I		11	4055.21 Mn I	
9	4047.28 Ce II		18	4050.48 Zr I		75	4055.47 Er II	
7	4047.35 Sm II		130	4050.58 Dy II		140	4055.54 Mn I	
24 c	4047.52 Ho		6	4050.81 Ce II		54	4055.71 Zr I	
30	4047.62 U I		8	4050.89 Th I		6	4055.80 Tm I	
240	4047.64 Y I		28	4050.96 V I		8	4055.84 Ce I	
7	4047.73 Dy I		50	4051.15 Nd II		26	4056.01 Mo I	
240	4047.79 Sc I		40	4051.15 Pr II		7	4056.32 Mo I	
15	4047.81 Gd II		28	4051.35 V I		2.0	4056.34 Rh I	
5	4047.94 W I		130	4051.40 Ru I		200	4056.54 Pr II	
9	4047.96 Hf II		15	4051.43 Ce II		20	4056.59 Sc I	
14	4048.05 Os I		5	4051.43 Os I		5	4056.83 Nd II	
16	4048.14 Pr		6	4051.49 Tb II		6	4056.90 Ce II	
4	4048.29 Th II		18	4051.52 Nb I		3.5	4056.94 Nb I	
7	4048.35 Dy II		4	4051.73 Mn I		22	4057.07 V I	
22	4048.35 Er II		28	4051.86 Tb II		1.2	4057.20 Co I	
5	4048.41 Rh I		40	4051.91 U II		3.0	4057.27 Nb I	
4	4048.43 Th II		15	4051.99 Ce II		10	4057.40 Dy II	
10	4048.60 Gd II		16	4052.20 Ru I		30	4057.55 Ho I	
14	4048.62 Sm II		4	4052.28 Yb I		4	4057.58 Mo I	
4	4048.62 V I		5	4052.47 Mn I		7	4057.62 Ti I	
55	4048.67 Zr II		8	4052.58 Pr II		10	4057.82 V I	
80	4048.76 Mn I		28	4052.87 Tb II		3400	4057.83 Pb I	
13	4048.78 Cr I		2.5	4052.92 Co I		16	4057.95 Mn I	
24	4048.81 Nd II		13	4053.03 U II		7	4058.14 Ti I	
6	4048.82 Tb I		4	4053.26 V I		32	4058.16 U	
20	4048.90 Dy I		75	4053.29 Gd II		3.5	4058.19 Co I	
20	4048.99 Re I		3.5	4053.44 Rh I		12	4058.19 Pr	
6	4049.00 Mn I		50	4053.51 Ce II		240	4058.22 Gd I	
8	4049.03 Ce II		10	4053.52 Th I		6	4058.24 Ce II	
2	4049.04 Rh I		240	4053.64 Gd I		7	4058.46 Ta I	
25	4049.20 Gd I		20	4053.86 Dy I		3.5	4058.60 Co I	
11	4049.35 Dy I		900	4053.93 Ho I		10	4058.77 Cr I	
6	4049.41 Ru I		10	4053.94 W I		3.5	4058.78 Ce II	
120	4049.43 Gd II		14	4054.00 Tb I		40	4058.78 Pr II	
6	4049.45 Hf II		65	4054.05 Ru I		30	4058.87 Sm II	
16	4049.48 Er II		40	4054.12 Tb I		80	4058.93 Mn I	
5	4049.58 Sm II		22	4054.31 U II		1700 c	4058.94 Nb I	
6	4049.74 Hf I		11	4054.43 Zr I		10	4059.25 Th I	
18	4049.76 Nb I		70	4054.45 Lu I		10	4059.37 Gd II	
40	4049.81 Sm II		60	4054.48 Ho II		10	4059.37 Pr	
6 d	4049.83 Th II		500	4054.55 Sc I		11	4059.39 Mn I	
	4049.95 Th I		75	4054.72 Gd I		44	4059.51 Er I	
200	4049.86 Gd II		200	4054.85 Pr II		22	4059.51 Nb I	
5	4049.87 Tb II		5	4054.86 Nd II		18	4059.61 Mo I	
11	4049.95 Sc I		32	4054.99 Ce II		55	4059.81 Er II	
120	4050.04 U II		24	4055.02 Ti I		60	4059.88 Gd I	
32	4050.08 La II		70	4055.03 Zr I		50	4059.96 Nd II	
3	4050.09 Mo I		42	4055.15 Dy II		6	4060.10 U	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
34	4060.26 Ti I		4	4064.32 Th I		30	4068.84 Ce II	
24	4060.31 Ho I		34	4064.46 Ru I		65	4069.20 Th II	
12	4060.31 Nb I		95	4064.58 Sm II		65	4069.28 Nd II	
22	4060.33 La I		22	4064.63 Ta I		16	4069.80 W I	
38	4060.40 Tb I		16	4064.79 La I		220	4069.88 Mo I	
8	4060.47 Ce		20	4064.79 W I		40	4069.92 Ir I	
7	4060.58 Dy II		9	4064.81 Nb I		80	4069.95 W I	
5	4060.71 W I		6	4064.91 Ce II		3.0	4070.04 Nb I	
3.5	4060.72 Ce I		7	4065.08 Au I		4	4070.09 Ce II	
36	4060.79 Nb I		6	4065.08 Mn I		14	4070.13 Tb I	
20	4060.87 Tb II		190	4065.09 Ho II		15	4070.26 Pr II	
280	4061.09 Nd II		17	4065.10 Ti I		22	4070.28 Mn I	
4	4061.26 Nb I		6	4065.16 Ce II		70	4070.29 Gd II	
25	4061.30 Gd II		6	4065.58 La I			4070.39 Gd II	
10 h	4061.34 Pr II		4	4065.62 Th I		10 d	4070.54 Tb II	
6	4061.35 U			4065.68 Th II		38	4070.61 W I	
44	4061.40 Ta I		3.5	4065.72 Cr I		16	4070.68 Ir I	
30	4061.53 Zr I		24	4066.04 Gd I		5	4070.72 Tb I	
14	4061.54 Nb I		9	4066.12 Nb I		5	4070.84 Ce II	
120	4061.59 Tb I		12	4066.21 Hf I		22	4070.86 Os I	
55	4061.74 Mn I		36	4066.22 Tb II		14	4070.96 Nb I	
8	4061.74 U		15	4066.37 Co I		6	4071.08 Ce II	
2.0	4061.81 Ce I		8	4066.37 Mo I		30	4071.11 U	
5	4061.86 Re I		6	4066.50 Ce II		10	4071.22 Tb I	
130	4062.08 Mo I		85	4066.69 Os I		14	4071.40 Ru I	
55	4062.14 Pb I		55	4066.74 Sm II		6	4071.46 Nd II	
20	4062.22 Ce II		8	4066.80 U		18	4071.54 V I	
20	4062.23 Pr II		4	4066.91 Ce I		17	4071.56 Os I	
3.0	4062.44 Fe I		7	4066.94 Cr I		100	4071.74 Fe I	
65	4062.55 U II		18	4067.16 Nb I		4	4071.74 Th I	
60	4062.59 Gd II		11	4067.24 Ta I		75	4071.81 Ce II	
300	4062.82 Pr II		20	4067.28 Ce II		30	4071.83 Ho	
20	4062.84 Hf I		85	4067.39 La II		11	4071.93 W I	
5	4062.85 Ru I		4	4067.45 Th I		4	4072.07 Nb II	
16	4062.94 Ce II		19	4067.57 Ho I		11	4072.39 Er I	
11	4062.99 Ru I		18	4067.61 Ru I		17	4072.52 Pr	
180	4063.39 Gd II		5	4067.73 Nd I		8	4072.65 Dy II	
18	4063.40 Th II		38	4067.76 U II		12 d	4072.69 Tb I	
55	4063.53 Mn I		33	4067.91 Ta I		180	4072.70 Zr I	
38	4063.54 Sm II		6	4068.00 Mn I		19	4072.92 Ce II	
50	4063.59 Gd II		80	4068.05 Ho I		18	4073.00 Ru I	
120	4063.60 Fe I		22	4068.26 Nb I		4	4073.00 Ta I	
20	4063.89 Tb II		48	4068.33 Sm II		30	4073.13 Ho	
8	4063.92 Ce II		48	4068.35 Gd I		200	4073.15 Dy II	
18	4063.93 V I		70	4068.37 Ru I		9	4073.15 W I	
10	4064.10 Ru I		6	4068.44 Ce		60	4073.20 Gd II	
8	4064.16 U		6	4068.54 Co I		130	4073.48 Ce II	
140	4064.16 Zr I		7	4068.72 Zr I		32	4073.51 Ho I	
17	4064.22 Ti I		24	4068.74 Gd I		9	4073.51 Nb I	
19	4064.32 Sm II		19	4068.80 Pr II			4073.64 Nb I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
15	4073.74 Ce II		3.0 h	4078.24 Eu I		48	4082.78 Rh I	
10	4073.75 Tb II		22	4078.31 Zr I		7	4082.79 Ru I	
28	4073.76 Gd II		38	4078.32 Ce II		12	4082.80 Tb I	
7	4073.94 Tb I		5	4078.35 Nb I		5	4082.93 V I	
10	4074.02 Dy II		120	4078.44 Gd II		80	4082.94 Mn I	
11	4074.02 Er II		9	4078.47 Tb II		16	4082.97 W I	
12	4074.16 Tb I		70	4078.47 Ti I		11	4083.08 Zr I	
550	4074.36 W I		19	4078.52 Ce II		11	4083.09 Er I	
8	4074.42 Nd II		14	4078.57 Sc I		7	4083.10 Dy I	
22	4074.49 U II		4	4078.60 Nb I		10	4083.21 Tb I	
2.0	4074.65 Ce II		260	4078.70 Gd I		65	4083.23 Ce II	
20	4074.68 Os I		5 d	4078.79 Tb I		6	4083.24 Sm II	
8	4074.84 Pr		6	4079.02 Ce II		44	4083.34 Pr II	
3.0	4074.86 Cr I		12	4079.18 La I		16	4083.35 Hf I	
28	4074.93 Zr I		7	4079.19 Ta I		5	4083.36 Re I	
14 h	4074.97 Sc I		55	4079.24 Mn I		5	4083.47 Th I	
42	4075.12 Nd II		6	4079.27 Dy I		8	4083.48 Ce II	
24	4075.22 Tb I		55	4079.42 Mn I		5	4083.58 Re I	
18	4075.25 Mo I		10	4079.67 Ce II		19	4083.58 Sm II	
28	4075.28 Nd II		3.5	4079.72 Ti I		80	4083.63 Mn I	
4	4075.50 Th I		1200	4079.73 Nb I		8	4083.64 Ce	
5	4075.54 Mo I		44 c	4079.79 Pr II		26	4083.67 Ho I	
110	4075.71 Ce II		7	4079.83 Sm I		48	4083.70 Gd I	
55	4075.84 Sm II		13 c	4080.23 Ho II		200	4083.71 Y I	
110	4075.85 Ce II		28	4080.23 Nd II		4	4083.78 Nb I	
3.5	4076.06 Cr I		19	4080.44 Ce II		9	4084.18 Nb I	
6	4076.09 Nb I		18	4080.53 Gd I		10	4084.27 Tb I	
18	4076.19 Mo I		16	4080.56 Sm II		1.6	4084.28 Rh I	
5	4076.21 Pr		550	4080.60 Ru I		14	4084.30 Zr I	
15	4076.24 Ce II		24	4080.61 U		90	4084.38 Mo I	
18	4076.53 Zr I		4	4080.70 Th I		15	4084.40 Sm II	
19	4076.65 Sm II		44 c	4081.02 Pr II		6	4084.68 Gd II	
11	4076.71 La II		2.0	4081.13 Ta I		9 c	4084.74 Pr	
24	4076.72 U		44	4081.21 Er II		10	4084.84 Tb I	
90	4076.73 Ru I		48	4081.22 Ce II		28	4084.86 Nb I	
6	4076.86 Sm II		9 h	4081.22 Y I		14 h	4084.93 U II	
3.5	4077.09 Cr I		180	4081.22 Zr I		50	4085.04 Th II	
8	4077.09 Nb I		36	4081.24 Tb I		16	4085.09 Ho I	
5	4077.28 Yb II		8	4081.37 Th I		9	4085.13 Pr	
280	4077.35 La II		24	4081.43 Re I		15	4085.14 Dy I	
950	4077.38 Y I		120	4081.44 Mo I		32	4085.23 Ce II	
30	4077.47 Ce II		70	4081.90 Pr II		5	4085.34 Pr	
6	4077.57 Rh I		9	4081.97 Sm II		30	4085.36 Dy I	
14	4077.62 Nd		2.5 h	4082.24 Tb II		8	4085.38 Eu II	
3.5	4077.68 Cr I		8	4082.26 Th II		28	4085.43 Ru I	
4600	4077.71 Sr II		6	4082.30 Zr I		6	4085.43 Th I	
16	4077.79 U		550	4082.40 Sc I		140	4085.56 Gd II	
12	4077.81 Hg I		24	4082.46 Ti I		14	4085.66 Zr I	
34	4077.88 Er I		8	4082.55 Nd II		4	4085.80 Ta I	
600	4077.98 Dy II		28	4082.60 Sm II		14	4085.82 Nd II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
14	4086.02 Mo I		5	4089.74 Ce II		24	4093.72 Gd I	
3.0	4086.16 Sm		5	4089.86 Ce II		11	4093.96 Ce II	
5	4086.24 Pr		5	4089.87 Pr		20	4094.05 Sm II	
12	4086.31 Co I		4	4089.92 Re I		12	4094.05 Tb I	
6	4086.42 Ce II		5	4089.94 Mn I		750	4094.19 Tm I	
50	4086.52 Th II		160	4090.14 U II		11	4094.27 Zr I	
19	4086.62 Tb I		14	4090.16 Nb I		5	4094.28 V I	
9	4086.63 Nb I		6	4090.30 Tm II		24	4094.37 Tb II	
18	4086.67 Sc I		60	4090.41 Gd I		24	4094.48 Gd II	
550	4086.72 La II		9	4090.47 Ce II		24	4094.50 Tb I	
6	4086.75 Pr		14	4090.51 Zr II		8	4094.62 Nd II	
4	4086.82 Nd		90	4090.58 V I		6	4094.62 U	
4	4087.05 Nb I		7	4090.74 Pr		11	4094.66 Er II	
36	4087.16 Sc I		14	4090.79 Zr I		50	4094.75 Th II	
18 c	4087.21 Pr II		9	4090.95 Ce II		13	4094.78 Ho I	
15	4087.22 Dy II		5	4091.00 Nd II		6	4094.85 Sc I	
3.5	4087.28 Th I		10	4091.06 Ru I		6	4094.89 U	
32	4087.34 Pd I		4	4091.26 Ta I		8 c	4094.97 Pr II	
19	4087.35 Ho I		3.5	4091.34 Th II		5	4095.43 Nd II	
18	4087.36 Ce II		6 d	4091.35 Tb I		70	4095.49 V I	
7	4087.38 Dy I		6	4091.49 Tm II		2.0 h	4095.55 Ta II	
5	4087.57 Ce II		16	4091.52 U		5	4095.56 Nb I	
22	4087.59 Ho I		15	4091.53 Dy II		11	4095.70 W I	
280	4087.65 Er I		16	4091.64 Ho I		16	4095.75 U	
24	4087.69 Gd II		8	4091.64 U I		11	4095.93 Tb I	
7	4087.69 Zr I		4	4091.75 Gd I		7	4095.97 Pr	
4	4087.70 Tb II		10	4091.77 Dy II		32	4096.12 Dy I	
4	4087.79 Rh I		6	4091.78 Er I		8 bl	4096.13 Lu LuO	
3.0	4087.96 Hf I		44	4091.82 Os I		16	4096.13 Nd II	
20	4088.25 U II		4	4091.94 V I		7	4096.34 Pr II	
14	4088.33 W I		3.5	4092.09 Ce II		16	4096.35 U	
6	4088.44 Os I		19	4092.20 Tb I		6	4096.63 Zr II	
5	4088.50 Rh I		70	4092.27 Sm II		8	4096.69 Dy I	
5	4088.56 Nd II		36	4092.39 Co I		6	4096.71 Nd II	
3.0	4088.58 Ce II		14	4092.41 V I		5	4096.80 Eu II	
5	4088.72 Th I		11	4092.61 Ir I		17	4096.81 Mo I	
5	4088.77 W I		7 h	4092.63 Pr		50	4096.82 Pr II	
16	4088.85 Ce II		140	4092.69 V I		10	4097.03 Ru I	
3.5	4088.87 Pr		100	4092.71 Gd I		4	4097.19 Ta I	
3.5	4089.07 Pr		7	4092.72 Ce II		4	4097.33 Th II	
4	4089.12 Nd II		3.5	4092.85 Pr		9	4097.36 Tb II	
4	4089.14 Th I		17	4092.90 Er I		10	4097.48 Tb II	
11	4089.35 Tb II		3.5	4093.04 Sm II		12	4097.52 Rh I	
5	4089.47 Pr		3.5 h	4093.13 Sc I		4 h	4097.64 Nb I	
2.0	4089.48 Sm		48	4093.16 Hf II		5	4097.67 W I	
7	4089.49 Dy I		5	4093.16 Zr I		8	4097.74 Th I	
5	4089.51 Tb II		3.5	4093.29 Ce I		85	4097.79 Ru I	
18	4089.61 La I		6	4093.39 Th II		34	4098.03 U II	
7	4089.68 Nd II		9	4093.50 V I		5	4098.10 Os I	
26	4089.69 Yb I		7	4093.66 Dy I		85	4098.11 Er I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
2.5	4098.15 Ce I		46	4102.16 V I		4	4106.35 Tb I	
5	4098.18 Mo I		7	4102.28 Ru I		6	4106.38 Dy II	
13	4098.18 Nd II		5	4102.36 Ce II		6 h	4106.39 Y I	
5	4098.22 Nb I		1000	4102.38 Y I		30	4106.50 Ho I	
5 h	4098.35 Sc I		5	4102.53 Nd II		12	4106.58 Hf I	
34	4098.41 Pr II		8	4102.53 Tb II		12	4106.59 Nd II	
240	4098.61 Gd II		4	4102.62 Th I		6	4106.62 Sm II	
5	4098.62 Tb II		110	4102.70 W I		5	4106.63 Er	
5	4098.65 Pr		14	4103.12 U		3.5	4106.78 Nb I	
14	4098.74 Mo I		7	4103.21 Tb I		9	4106.85 Ce	
48	4098.90 Gd II		320	4103.34 Dy II			4106.92 Ce II	
6	4098.91 Nd II		16	4103.36 Tb I		4	4106.88 Eu I	
12	4098.94 Th II		8	4103.46 Tb I		15	4106.93 U II	
8	4098.97 Sm II		5	4103.62 Os I		2.5	4107.11 Pr	
6	4098.98 Ce II		3.5 d	4103.65 Th II		55	4107.28 Sm II	
4	4099.03 W I			4103.68 Th I			4107.39 Sm II	
18	4099.07 Nb I		1000	4103.84 Ho I		11	4107.36 Ho I	
4	4099.15 Tb		70	4103.88 Dy I		4	4107.37 Th II	
7	4099.17 Ti I		24	4103.90 Tb II		36	4107.42 Ce II	
10	4099.31 Zr I		5	4104.00 Er II		3.5 h	4107.44 Lu I	
7 d	4099.48 Tb II		16	4104.13 Sm II		7	4107.44 Nd II	
28	4099.54 La II		10	4104.23 Hf I		70	4107.47 Mo I	
3	4099.75 Ce II		9	4104.23 Nd II		4	4107.49 Fe I	
220	4099.80 V I		10	4104.38 Th II		4	4107.49 Rh I	
8	4099.87 Dy I		18	4104.40 V I		5	4107.49 V I	
4	4099.96 Sm I		14	4104.42 Re I		3.0	4107.50 Pr	
26	4100.22 Ho I		3.5	4104.43 Ce II		14	4107.50 Zr I	
14	4100.22 Pr II		3.0	4104.54 Nd II		8	4107.75 Pr II	
11	4100.24 Nd II		1.4	4104.75 Co I		5	4107.79 Tb I	
60	4100.26 Gd I		20	4104.78 V I		3.5	4107.80 Ce II	
11	4100.30 Os I		3.0	4104.86 Pr		4	4107.80 Sm II	
6	4100.33 Sc I		3.5	4104.87 Cr I		12	4107.84 Ru I	
11	4100.34 Th I		11	4104.87 La I		4	4107.86 Th I	
7	4100.37 Ru I		9	4104.99 Gd I		5	4107.93 Tm I	
46	4100.40 Nb I		18	4105.00 Ce II		7	4107.96 Nd II	
28	4100.58 Er II		13	4105.02 Ta I		9	4108.22 V I	
260 c	4100.75 Pr II		13	4105.04 Ho		1.8	4108.26 Ce II	
10	4100.84 Th II		16	4105.05 Dy II		9	4108.32 Sm II	
12 d	4100.90 Tb I		14	4105.08 Mo I		6	4108.34 Pr	
700	4100.92 Nb I		220	4105.17 V I		5	4108.36 U I	
10	4101.09 Ho I		19	4105.34 Th II		7	4108.40 Gd II	
5	4101.45 Nd II		4	4105.36 Mn I		18	4108.40 Zr I	
12	4101.65 Tb I		60	4105.37 Tb I		60	4108.42 Th II	
32	4101.74 Ru I		5	4105.53 Mo I		6	4108.53 W I	
1700 c	4101.76 In I		10	4105.73 Pr II		320	4108.62 Ho I	
32	4101.77 Ce II		700	4105.84 Tm I		80	4109.08 Nd II	
5	4101.85 W I		5	4105.91 Th II		3.0	4109.09 Pr	
15	4101.91 U I		5	4106.13 Ce II		4	4109.32 Th I	
6	4101.94 Dy II		8	4106.18 Nb I		10	4109.34 Er I	
24	4102.15 Mo I		28	4106.28 U		28	4109.40 Sm II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
3.0	4109.41 Pr		12	4112.88 Tb I		14	4118.18 V I	
150	4109.46 Nd II		6	4112.94 Gd I		11	4118.18 W I	
3.0	4109.56 Ce II		10	4113.05 Dy I		5	4118.43 Tb I	
3.5	4109.58 Cr I		8	4113.11 U II		150 c	4118.48 Pr II	
2.5	4109.65 Ru I		5	4113.35 Nb I		3.5	4118.48 Th I	
16	4109.76 W I		15	4113.38 Ru I		6	4118.50 Ru I	
180	4109.79 V I		5	4113.40 Re I		26	4118.55 Er I	
5	4109.80 La I		18	4113.52 V I		8	4118.55 Fe I	
3.0	4109.81 Fe I		10	4113.53 Hf II		130	4118.55 Sm II	
4	4109.88 Nb I		7	4113.73 Ce II		10	4118.60 Hf I	
5	4110.09 Tb I		4	4113.77 Gd II		14	4118.64 V I	
2.5 h	4110.11 Pr		18 h	4113.83 Nd II		11	4118.69 Pt I	
19	4110.19 Sm II		24 c	4113.89 Pr II		120	4118.77 Co I	
14	4110.38 Ce II		28	4113.90 Sm II		6	4118.91 Hf I	
4	4110.43 Gd II		18	4113.94 Nb I		10	4118.94 Ho I	
5	4110.47 Pr		3.0	4114.13 Ru I		9	4118.96 Mo I	
30	4110.48 Nd II		5 h	4114.13 Tb II		18	4119.02 Ce II	
8 d	4110.51 Th II		3.5	4114.15 Ce II		6	4119.21 Gd I	
24	4110.54 Co I		5	4114.53 V I		7 h	4119.26 Yb II	
6	4110.57 W I		2.0	4114.77 Ta I		9	4119.28 Nb II	
14	4110.60 Gd II		5	4114.84 Pr		3.0	4119.30 Eu II	
	4110.64 Th II		8	4114.93 Mo I		16	4119.33 Dy II	
8	4110.81 Y I		340	4115.18 V I		4	4119.37 Pr	
5	4110.84 Ce II		5 d	4115.36 Tb II		6	4119.38 Gd II	
5	4110.86 Tb I		30	4115.37 Ce II		18	4119.46 V I	
6	4110.86 Th II		7	4115.38 Gd II		10	4119.57 Sm II	
24 c	4110.89 Re I		6	4115.59 W I		10	4119.68 Rh I	
15	4110.90 Mn I		20 bl	4115.76 Th ThO		22	4119.79 Ce II	
4	4110.92 Pr		15	4115.78 Ir I		8	4119.80 Pr	
120	4111.34 Dy II		4	4115.83 Pr		10	4119.83 Zr I	
18	4111.39 Ce II		3.0	4115.90 Hf I		22	4119.88 Ce II	
36	4111.44 Gd II		60	4116.10 U II		24	4119.96 Tb I	
12	4111.74 Gd II		6	4116.33 Rh I		3 h	4120.00 Pr	
700	4111.78 V I		4	4116.34 Nd		60	4120.10 Mo I	
11	4111.81 W I		26	4116.36 Er I		170	4120.20 Ho I	
13 c	4111.87 Pr II		13	4116.46 Sm II		10	4120.51 Tb II	
2.5	4111.93 Ce II		140	4116.47 V I		14	4120.54 V I	
34	4112.00 Ho I		75	4116.71 Th II		3.5	4120.61 Cr I	
110	4112.02 Os I		30	4116.73 Ho I		5	4120.66 Nd II	
6 h	4112.04 Eu II		2.0	4116.77 Nd II		32	4120.83 Ce II	
14	4112.13 Nb I		4	4116.89 U		11	4120.86 W I	
9	4112.33 V I		32	4116.90 Nb I		2.5	4120.96 Pr	
28	4112.50 Tb I		18	4117.01 Ce II		15	4120.99 Ru I	
11	4112.63 Er II		10	4117.23 Tb I		8	4121.03 Tb I	
10 h	4112.67 Lu I		14	4117.29 Ce II		190	4121.32 Co I	
18	4112.71 Ti I		14	4117.59 Ce II		28	4121.36 Sm II	
11	4112.72 Ho I		5	4117.68 La I		36	4121.46 Zr I	
2.5 h	4112.74 Pr		17	4118.05 W I		14	4121.53 Bi I	
170	4112.74 Ru I		2.0	4118.07 Ta I		8	4121.54 Sm II	
17	4112.75 Th I		55	4118.14 Ce II		19	4121.64 Re I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
90	4121.68	Rh I	5	4125.78	Gd I	3.0	4129.87	Nd I
3.5	4121.82	Cr I	6	4125.85	Sm II	80	4129.93	Nb I
14	4121.86	Bi	12	4126.12	Dy I	13	4130.14	Tb I
5	4121.94	Nd II	5 h	4126.15	Pr	4	4130.33	Th I
6	4122.02	W I	12	4126.52	Cr I	200	4130.37	Gd II
3.0	4122.16	Cr I	5	4126.53	Mo I	28	4130.42	Dy I
7	4122.17	Ti I	4	4126.66	Ce II	150 h	4130.66	Ba II
10	4122.47	Tb I	8	4126.71	Tb I	38	4130.71	Ce II
32	4122.49	Lu I	17	4126.80	W I	3.0	4130.72	Nd II
19	4122.51	Sm II	5	4126.90	Nb I	30	4130.77	Pr II
4	4122.67	Th II	480	4127.16	Ho I	8	4131.00	Th I
12	4122.81	Nb I	5	4127.28	Eu I	10	4131.04	Dy II
11	4123.05	Er II	13	4127.29	Tb I	34	4131.10	Ce II
15	4123.06	Ru I	3.0	4127.30	Cr I	5	4131.11	Tb I
6	4123.06	W I	70	4127.37	Ce II	11	4131.12	Mn I
6	4123.17	Ta I	14	4127.41	Th I	3.5	4131.25	Ti I
14	4123.19	V I	11	4127.44	Ru I	3.5	4131.36	Cr I
440	4123.23	La II	9	4127.45	Nb I	8	4131.42	Th II
36	4123.24	Ce II	11	4127.54	Ti I	13	4131.45	Tb I
3.5	4123.31	Ti I	2.0	4127.61	Fe I	25	4131.48	Gd II
3.5	4123.39	Cr I	3.5	4127.64	Cr I	48	4131.50	Er I
36	4123.49	Ce II	4	4127.72	Gd II	9	4131.53	Nb I
8	4123.53	Th II	18	4127.74	Ce II	16 c	4131.79	Lu I
7	4123.57	Ti I	13	4127.80	Hf II	2.0	4131.86	Ce
160	4123.57	V I	11	4127.87	Ru I	17	4131.92	Mo I
13	4123.65	Mo I	9	4127.88	Ta I	10	4132.02	U
550	4123.81	Nb I	2.5	4127.92	Ir I	240	4132.02	V I
6	4123.81	Ru I	7 h	4127.96	Zr I	32	4132.06	Fe I
70	4123.87	Ce II	14	4128.07	Ce II	6	4132.21	W I
24	4123.88	Nd II	240	4128.07	V I	7	4132.23	Mo I
48	4123.96	Sm II	2.0	4128.12	Sm	15 c	4132.23	Pr II
8	4124.06	Pr	14	4128.28	Mo I	4	4132.23	Tb
9	4124.07	V I	32	4128.29	Dy II	100	4132.28	Gd II
8	4124.35	Pr	900	4128.31	Y I	5	4132.28	Re I
13	4124.54	Mo I	30	4128.34	U	7	4132.31	Ce II
16	4124.60	Os I	13	4128.36	Ce II	6	4132.43	Ba I
40	4124.65	Dy II	5	4128.70	Nd II	13	4132.48	Tb I
320	4124.73	Lu I	7	4128.83	Mo I	5	4132.56	Nd II
30	4124.73	U II	9	4128.86	V I	4	4132.64	Ce II
36	4124.79	Ce II	130	4128.87	Rh I	9	4132.69	Tm II
11	4124.80	Er I	16	4128.96	Os I	24	4132.75	Th II
32	4124.92	Y II	28	4129.13	Dy I	8	4132.83	Tb I
3.0	4125.05	Nd II	22	4129.15	Pr II	6	4132.85	Dy II
8	4125.06	Pr	3.5	4129.17	Ti I	40 h	4133.00	Sc I
11	4125.18	W I	6	4129.18	Ce II	7	4133.19	Sm II
4	4125.23	Sm I	19	4129.23	Sm II	10	4133.20	U
8	4125.25	Nb I	22	4129.38	Ta I	28	4133.36	Nd II
5	4125.58	Nb I	70	4129.43	Nb I	14	4133.38	Dy II
140	4125.65	Ho I	80	4129.44	Dy II	24 cw	4133.42	Re I
3.5	4125.78	Ce II	2200 cw	4129.70	Eu II	10 h	4133.46	Th

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
11	4133.48 W I		240	4137.10 Nb I		26	4142.19 Ho I	
15	4133.50 U I		3.0	4137.16 Pr		5	4142.24 Nb I	
5	4133.51 Tb I		9	4137.23 Ru I		12	4142.26 W I	
18	4133.62 Pr II		12	4137.29 Ti I		55	4142.40 Ce II	
190	4133.80 Ce II		60	4137.46 W I		5	4142.45 Tb I	
32	4133.86 Dy I		19	4137.47 Ce II		12	4142.48 Th II	
14	4134.06 Th I		8	4137.59 Nb I		18	4142.70 Th II	
	4134.11 Th II		5	4137.60 Re I		5	4142.81 Sm II	
20	4134.14 Dy I		140	4137.65 Ce II		11	4142.83 Ce II	
70	4134.16 Gd I		13	4137.84 Os I		750	4142.85 Y I	
7	4134.31 Zr I		17	4138.02 W I		44	4142.92 Er II	
5 d	4134.32 Tb		4	4138.03 Gd I		7	4143.05 Ti I	
180	4134.49 V I		19	4138.10 Ce		100	4143.10 Dy II	
34	4134.54 Ho I		3.0	4138.19 Pr		240	4143.14 Pr II	
18	4134.59 Nb I		5	4138.30 Nb I		36	4143.21 Nb I	
4	4134.68 Fe I		10	4138.30 W I		5	4143.24 Tb I	
5	4134.72 Nd II		80	4138.34 Tm I		8	4143.42 Fe I	
8	4134.73 Dy I		15	4138.35 Ce II		26	4143.49 Tb I	
9	4135.04 Mn I		12	4138.54 Dy I		280	4143.55 Mo I	
10	4135.08 Ho I		7	4138.66 U		13	4143.57 Tb I	
4	4135.09 Yb II		3.5	4138.97 Sm II		40	4143.87 Fe I	
17	4135.14 Sm II		5	4139.06 Tb I		180	4144.16 Ru I	
180	4135.27 Rh I		14	4139.14 U II		2.5	4144.23 Pr	
30	4135.33 Nd II		5 b	4139.19 Th ThO		4	4144.25 Gd I	
12	4135.37 Tb I		5	4139.26 V I		70	4144.36 Re I	
4	4135.38 Mo I		6	4139.32 W I		100	4144.46 Tb II	
8	4135.42 Nb I		14	4139.34 Ho I		10	4144.56 Nd II	
19	4135.44 Ce II		4	4139.43 Ce II		11	4144.70 U II	
3.0	4135.50 Sm I		46	4139.44 Nb I		28	4144.49 Ce II	
14	4135.68 Zr I		10	4139.56 Dy I		48	4145.00 Ce II	
7	4135.76 U II		280	4139.71 Nb I		15	4145.16 W I	
220	4135.78 Os I		13	4139.79 Tb I		5	4145.24 Sm I	
4	4135.89 Ce II		3.5	4140.01 Zr I		4	4145.39 U II	
5	4136.11 V I		16	4140.23 Th II		60	4145.74 Ru I	
24	4136.20 Ta		48 h	4140.30 Sc I		12	4145.76 Hf I	
170	4136.22 Ho I		2.5 h	4140.32 Pr		4	4145.84 Th I	
10 d	4136.28 Th I		11	4140.45 Gd II		12	4145.95 W I	
	4136.40 Th II		4	4140.75 Ce II		5	4146.00 Nb I	
6	4136.35 W I		2.0	4141.02 Eu II		80	4146.07 Dy I	
180	4136.45 Re I		4	4141.02 Gd II		8	4146.13 Nd II	
3.5	4136.47 Tb I		6	4141.06 Mn I		34	4146.23 Ce II	
2.0	4136.59 Eu II		34	4141.23 U II		24 c	4146.54 Pr II	
6	4136.76 Nd II		130 c	4141.26 Pr II		4	4146.61 U	
4	4136.77 Ce II		38	4141.51 Dy II		11	4146.75 Sm II	
10	4136.81 U II		13	4141.55 Tb I		24	4146.77 Ru I	
6	4136.90 Ce II		11	4141.63 Th II		10	4146.96 Tb I	
3.5	4137.03 Tb		4	4141.72 Eu II		2.5	4147.14 Pr	
11	4137.04 La I		55	4141.74 La II		17	4147.19 Nb I	
2.5	4137.07 Eu I		5	4141.86 U I		6	4147.37 Zr I	
38	4137.10 Gd II		6	4142.00 Pr		6 h	4147.40 Sc I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
4	4147.53 Mn I		100	4151.97 Ce II		18	4156.52 Pr II	
4	4147.55 Pr		110	4151.97 La II		24	4156.52 Th II	
2.0	4147.67 Fe I		12	4152.04 Nb I		28	4156.66 U I	
22	4147.71 Sm II		4 d	4152.20 Th I		3.5	4156.68 Nb II	
24	4147.89 Ta I			4152.34 Th I		4	4156.79 Mo I	
6	4147.95 Dy I		80	4152.21 Sm II		4	4156.80 Fe I	
6	4148.16 Ce II		8	4152.24 Tb I		3	4156.90 Pr	
16	4148.18 Th II		7	4152.29 Re I		4 d	4157.27 Th I	
4	4148.21 Tb II		65	4152.36 Sc I			4157.39 Th I	
8	4148.38 Ru I		12 h	4152.43 Dy II		19	4157.40 Mo I	
24	4148.46 Pr II		460	4152.58 Nb I		4	4157.52 La I	
3.5	4148.65 Th I		110 cw	4152.61 Ho II		4	4157.58 Nd II	
	4148.72 Th I		5	4152.63 Re I		10 h	4157.63 Y I	
9	4148.74 Nb I		18	4152.64 Zr I		2.0	4157.72 Eu I	
6	4148.80 Mn I		3.5	4152.66 V I		5	4157.77 Pr	
26	4148.86 Gd I		2.5	4152.78 Cr I		18	4157.78 Gd I	
20	4148.90 Ce II		22	4152.78 La II		18	4158.01 Nb I	
22	4148.94 Mo I		4	4152.93 Ce		5	4158.28 Tb II	
32	4148.97 Ho I		8	4153.11 Dy I		1.2	4158.42 Co I	
28	4149.07 Yb I		16	4153.13 Ce II		3.5	4158.48 Gd I	
9	4149.14 Tm I		36	4153.33 Sm II		32	4158.53 Tb I	
10	4149.17 Tb II		10	4153.51 Gd II		8	4158.54 Th I	
110	4149.20 Zr II		6	4153.73 Nd II		9	4158.60 Tm I	
3.5	4149.32 Pr		7	4153.75 Zr I		6	4158.78 Os I	
6	4149.44 W I		10	4153.82 Cr I		7	4158.88 Hf II	
5	4149.48 Gd I		3.5	4153.93 Ce II		2.5	4158.98 Lu I	
30	4149.79 Ce II		65	4153.97 U I		32	4159.03 Ce II	
55	4149.83 Sm II		8	4154.05 Pr II		3.0	4159.17 Ru I	
70	4149.94 Ce II		48	4154.08 Lu I		10	4159.34 Dy I	
14	4149.96 Re I		6	4154.23 Dy I		7	4159.40 Sm II	
32	4149.99 Th II		20	4154.37 Rh I		3.5	4159.47 Pr	
7	4150.04 Pr II		4	4154.50 Fe I		7	4159.51 Sm II	
4	4150.11 Tm I		18	4154.68 W I		5	4159.55 Tm II	
90	4150.12 Nb I		5 h	4154.72 Sc		8	4159.57 Nd II	
5	4150.30 Ru I		18	4154.86 Gd II		7	4159.64 Ti I	
5	4150.54 Tb		38	4155.22 Sm II		6	4159.66 Th II	
4	4150.61 Gd II		6	4155.28 Ce		12	4159.69 V I	
3.5	4150.67 V I		24	4155.28 Mo I		2.5	4159.83 Pr	
5	4150.86 Tb I		8	4155.30 Th II		9	4159.92 Re I	
30	4150.91 Ce		20	4155.41 U II		6	4159.96 Os I	
14	4150.96 Ti I		5	4155.47 Th II		6	4160.04 W I	
14	4150.97 Zr II		13	4155.53 Ce II		10	4160.11 Ce II	
3.5	4151.01 Pr		17	4155.58 Mo I			4160.18 Ce II	
550	4151.10 Er I		3.0	4155.70 Ir I		6	4160.24 Dy I	
2.0	4151.52 Eu II		180	4156.08 Nd II		10	4160.26 La I	
3.5	4151.63 Gd II		9	4156.23 Th II		5	4160.30 Er	
3.0	4151.64 Eu II		26	4156.24 Zr II		5	4160.35 W I	
10	4151.68 Nd II		9	4156.25 Sm II		4	4160.47 Pr	
2.5	4151.74 Pr		30	4156.26 Nd II		20	4160.57 Nd II	
7	4151.88 Mo I		8	4156.28 Tb I		5	4160.80 Nb I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
5	4160.95 U I		20	4165.68 U II		16	4170.47 Th II	
8 h	4161.00 Ta I		10	4165.77 Th I			4170.54 Th I	
8	4161.18 Ce II		9	4165.85 Nb I		8	4170.49 Tb I	
36	4161.21 Zr II		20	4166.00 Ba II		18	4170.54 W I	
8	4161.25 Nb I		1.6	4166.04 Ir I		6	4170.55 Dy I	
11 cw	4161.36 Tb I		4	4166.20 Ce		6	4170.76 Nd II	
7	4161.42 Cr I		4	4166.28 Mo I		4	4170.78 Th II	
4 d	4161.59 Th II		3.5	4166.32 Ti I		10	4171.03 Ti I	
	4161.74 Th I		3.5	4166.34 Sm II		22	4171.05 Tb I	
12	4161.66 Ru I		36	4166.36 Zr I		8	4171.07 Mo I	
20	4161.80 Sr II		5	4166.51 Tb		50	4171.18 W I	
8 hd	4161.88 Sc I		5	4166.64 U		5	4171.30 V I	
2.0 h	4162.17 Co I		11	4166.65 Ce II		8	4171.34 Th II	
6	4162.25 Dy I		44	4166.88 Ce		4	4171.39 Ce II	
13	4162.36 Hf II		10	4166.88 Ru I		11	4171.48 Zr I	
18	4162.43 U I		26	4167.16 Gd II		6 h	4171.56 Sc I	
4	4162.51 Th I			4167.27 Gd I		28	4171.57 Sm II	
11	4162.63 Ce II		80	4167.51 Ru I		100	4171.59 U II	
17	4162.68 Mo I		240	4167.52 Y I		10	4171.68 Er	
10	4162.68 Th II		18	4167.80 Ce II		11	4171.71 Gd I	
10	4162.69 Hf I		460	4167.99 Dy I		14	4171.80 Tb I	
50	4162.73 Gd II		24	4168.00 Nd		55	4171.82 Pr II	
5	4162.81 Nb I		13	4168.03 Pb I		3.5	4171.90 Ti II	
900	4163.03 Ho I		4 h	4168.05 Th I		30	4171.93 Dy I	
26	4163.09 Gd II		24	4168.08 Pr II			4171.99 Dy I	
11	4163.14 Sm II		360	4168.13 Nb I		2000	4172.06 Ga I	
90	4163.47 Nb I		12	4168.63 Th II		8	4172.16 Ce II	
22	4163.52 Ce II		10	4168.66 W I		11	4172.17 Er I	
12	4163.62 Cr I		4	4168.76 Nd II		18	4172.23 Ho I	
12	4163.64 Th II		12	4169.06 U I		65	4172.27 Pr II	
6	4163.65 Ti II		22	4169.11 Tb I		5	4172.32 La I	
460	4163.66 Nb I		6	4169.24 Dy II		10	4172.56 Ir I	
26	4163.68 U II		22	4169.31 Tb I		16	4172.57 Os I	
7	4163.72 Sm II		7	4169.35 Ti I		22	4172.60 Tb I	
4	4164.08 Mo I		7	4169.36 Zr I		3.5	4172.77 Cr I	
3.0	4164.14 Ti I		20	4169.46 Pr II		7	4172.80 Eu II	
150 c	4164.19 Pr II		55	4169.48 Sm II		22	4172.82 Tb I	
8	4164.25 Th II		18	4169.57 Nb I		10	4172.97 U II	
3.5	4164.41 Nd		46	4169.77 Ce II		280	4173.23 Ho I	
8	4164.56 Pt I			4169.88 Ce II		110	4173.23 Os I	
420	4164.66 Nb I		8	4169.82 Mo I		6	4173.38 Nd II	
5	4164.79 U		3.5	4169.84 Cr I		24	4173.47 Tb I	
15	4164.82 Er I		10	4169.84 Pd I		11	4173.56 Gd II	
3.5	4164.85 Nd I		11	4169.92 Tb I		3.5	4173.70 Pr	
9	4165.04 Nd II		10	4170.05 Ru I		12	4173.95 Nb I	
4	4165.07 Th II		12	4170.11 Gd II		8	4174.01 V I	
100 h	4165.19 Sc I		3.0	4170.20 Cr I		200	4174.14 Y I	
6	4165.52 Cr I		16	4170.40 Re I		16	4174.19 U II	
3.0	4165.54 Sm II		5	4170.45 Tm I		100	4174.34 Hf I	
90	4165.61 Ce II		6	4170.46 Nd II		9	4174.34 Nb I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
13	4174.43	Sm II	6	4179.79	Tb II	6 h	4184.89	U
3.5	4174.46	Nd	7	4179.81	Zr II	3.0	4184.90	Cr I
8	4174.48	Ce II	11	4179.96	Th II	3.0	4184.90	Fe I
7	4174.57	Yb I	6	4180.24	W I	15	4184.98	Nd II
14	4174.80	Cr I	3.5	4180.40	Pr	12	4185.15	Pr II
6	4175.08	Tb I	17	4180.40	Tb I	24	4185.33	Ce II
2.0	4175.16	Eu II	6	4180.68	Pr II	11	4185.45	Er I
22	4175.21	Ta I	20	4180.82	Yb II	2.0	4185.66	Ir I
5	4175.24	Ce II	4	4180.88	Th I	5	4185.77	Nd
22	4175.30	Pr II	8	4181.05	Mo I	46	4185.82	Mo I
5	4175.43	Ru I	24	4181.08	Ce II	4	4185.82	Pr
220	4175.54	Gd I	36	4181.10	Sm II	6	4185.89	Tb I
48	4175.61	Nd II	14	4181.15	Ta I	5	4186.02	W I
55	4175.63	Os I	4	4181.25	Dy I	8	4186.04	Nd II
3.5	4175.64	Fe I	8	4181.33	Tb II	8	4186.10	Nb I
22	4175.64	Pr II	9	4181.34	Nb I	30	4186.12	Ti I
8	4175.84	Tb I	8	4181.76	Fe I	22	4186.24	Tb I
2.5	4175.94	Cr I	8	4182.16	Th II	5	4186.28	Mo I
9	4176.08	Ce II	7	4182.22	Eu I	2.5	4186.36	Cr I
9	4176.33	Pr	3.5	4182.33	Pr	5	4186.40	Pr II
3.5 d	4176.33	Th II	10	4182.46	Ru I	4 h	4186.45	Sc
	4176.48	Th I	4	4182.47	Ir I	250	4186.60	Ce II
11	4176.60	Mn I	5	4182.52	Nd II	9	4186.69	Zr II
11 d	4176.64	Dy I	12	4182.59	V I	950	4186.78	Dy I
	4176.81	Dy I	6	4182.64	Ru I	14	4186.96	U I
24	4176.70	Ce II	3.5	4182.67	Pr	13	4187.04	Fe I
8	4176.90	Ta II	9	4182.77	Gd I	4	4187.11	Nd
	4176.99	Ta I	22	4182.90	Re I	28	4187.16	Tb I
14	4177.26	Mo I	5	4182.92	Pr	1.2	4187.25	Co I
140	4177.32	Nd II	22	4183.06	Re I	38	4187.32	Ce II
5	4177.44	Nb I	4	4183.13	Nd I	28	4187.32	La I
7	4177.48	La I	1.6 h	4183.21	Ir I	60	4187.56	Zr I
800	4177.54	Y II	3.0	4183.30	Ti I	6 h	4187.62	Sc I
11	4177.92	Ta I	18	4183.32	Zr I	650	4187.62	Tm I
30	4178.02	Sm II	14	4183.33	Sm I	7	4187.66	Hf II
44	4178.06	Th II	4	4183.56	Th II	6	4187.79	Pr
19	4178.27	Mo I	20	4183.61	Dy I	13	4187.80	Fe I
10 d	4178.44	Nd II	6	4183.67	W I	14	4188.07	U II
	4178.53	Nd II	75	4183.73	Dy I	17	4188.09	Tb I
12	4178.64	Nd II	36	4183.76	Sm II	8	4188.10	Gd II
18	4178.64	Pr II	10	4183.83	W I	70	4188.13	Sm II
14 d	4178.98	Tb II	11	4184.13	Os I	4	4188.26	Nd
10	4179.00	U II	10	4184.24	Pr II	240	4188.32	Mo I
14	4179.26	Cr I	220	4184.25	Gd II	7	4188.51	Tb II
5	4179.29	Ce II	170	4184.25	Lu II	3.5	4188.69	Ti I
460	4179.42	Pr II	17	4184.29	Tb I	4	4188.82	Gd I
18	4179.42	V I	4	4184.39	Mo I	3.5	4189.18	Ce II
38	4179.59	Nd II	32	4184.44	Nb I	22	4189.28	U II
18	4179.71	Th II	3.5	4184.62	Pr	3.0	4189.46	Ru I
9	4179.76	Nb I	3.5	4184.71	Th II	220	4189.52	Pr II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
3.5	4189.56 Th I		26	4193.87 Ce II		11	4198.08 Ho I	
4	4189.64 Ce II		7	4194.01 Tb I		5	4198.17 Nd II	
14	4189.84 V I		3.5	4194.01 Zr I		10	4198.22 U I	
28	4189.91 Os I		60	4194.35 Ho I		11	4198.31 Fe I	
22	4189.99 Er II		24	4194.56 Mo I		8	4198.41 Tb I	
9	4189.99 Mn I		5	4194.62 Pr		13	4198.43 Ce II	
6	4189.99 Nb I		9	4194.67 Re I		32	4198.51 Nb I	
9	4190.00 Mo I		11	4194.70 Er I		7	4198.52 Cr I	
3.0	4190.13 Cr I		36	4194.76 Zr I		5	4198.61 V I	
6	4190.20 Gd I		550	4194.85 Dy I		80	4198.67 Ce II	
12	4190.63 Ce II		13	4194.91 Ce II			4198.72 Ce II	
4	4190.64 Pr		3.5	4194.93 Th I		8	4198.85 Nb I	
9	4190.65 Nb I		6	4194.95 Cr I		50	4198.88 Ru I	
80	4190.71 Er I		2	4195.03 Nd II		4	4199.02 Th II	
4	4190.71 Co I		90	4195.09 Nb I		11 d	4199.06 Tb I	
200	4190.78 Gd I		5	4195.14 Os I		55	4199.09 Zr I	
120	4190.88 Nb I		26	4195.22 Dy I		13	4199.10 Fe I	
26	4190.90 Dy I		2.5	4195.36 Eu II		7	4199.11 Nd II	
11	4190.95 Hf I		5 c	4195.52 Pr		12	4199.28 Y II	
4	4191.03 Ce		5	4195.56 Th II		18	4199.45 Sm II	
70	4191.07 Gd II		140	4195.66 Nb I		5	4199.63 W I	
14	4191.08 Tb I		5	4195.82 Ce II		700	4199.90 Ru I	
9	4191.16 Ta I		6	4195.83 Th II		38	4199.92 Tm II	
7	4191.27 Cr I			4195.95 Th II		6	4200.03 W I	
8	4191.44 Fe I		5	4195.96 Pr		4	4200.04 Nd II	
14	4191.56 V I		7	4196.13 Zr I		4	4200.10 U II	
17	4191.59 Tb I		2.5	4196.18 Eu II		4	4200.19 V I	
180	4191.60 Dy I		45	4196.34 Ce II		5	4200.57 Mo I	
50 c	4191.62 Pr II		28	4196.50 Rh I		6	4200.75 Ti I	
70	4191.63 Gd I		150	4196.55 La II		3.5	4200.99 Nb I	
11	4191.79 Zr I		36	4196.73 Tb I		42	4201.00 Tb II	
4	4191.82 Th II		10	4196.79 Pr		7	4201.13 U	
28	4191.93 Sm II		14	4196.87 Ru I		26	4201.18 Pr II	
4	4191.94 U I		5	4196.95 Nb I		1.8	4201.22 Sm II	
90	4192.07 Nb I		10	4197.07 Gd II		24	4201.24 Ce II	
3.0	4192.10 Cr I		3.0	4197.10 Pr			4201.32 Ce II	
3.5	4192.10 Zr I		3.5	4197.23 Cr I		55	4201.32 Dy I	
11	4192.16 Sm II		2.0	4197.29 Pr		5	4201.32 Mo I	
28	4192.36 La II		5	4197.39 Er I		16	4201.45 Os I	
2.0	4192.36 Th I		10	4197.51 Ce II		55	4201.46 Zr I	
4	4192.43 Pt I		13	4197.52 U II		36	4201.52 Nb I	
4 c	4192.50 Pr		2.5	4197.54 Ir I		10 c	4201.53 Pr II	
9	4193.02 Th I		50	4197.58 Ru I		5	4201.76 Mn I	
40	4193.09 Ce II		5	4197.60 V I		32	4201.85 Rb I	
6	4193.10 Ta I		5	4197.61 Nb I		12	4201.85 Th II	
7	4193.15 Gd II		13	4197.67 Ce II		34	4202.03 Fe I	
26	4193.28 Ce II		42	4197.68 Gd II		22	4202.06 Os I	
5	4193.35 Tb I		3.0	4197.90 Sm II		55	4202.25 Dy I	
7	4193.66 Cr I		20	4198.00 Ce II		8	4202.52 Gd II	
6	4193.83 Nb I		65	4198.02 Dy I		44	4202.92 Sm II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
65	4202.94 Ce II		11	4207.53 Tb I		7	4213.05 Sm II	
75	4203.05 Sm II		17	4207.64 Ru I		5	4213.07 Nd II	
14	4203.21 Ho I		11	4207.68 Dy I		4	4213.07 Th I	
7	4203.39 Ho II		11	4207.81 Pr II		150	4213.18 Dy I	
7	4203.41 Nb I		5	4208.08 Gd I		5	4213.22 Nd II	
4 h	4203.43 Nd II		16	4208.16 Nb I		9	4213.26 Nb I	
7	4203.46 Ti I		44	4208.31 Pr II		4	4213.26 Pr	
4	4203.51 Ce		3.0	4208.36 Cr I		7	4213.27 Re I	
5	4203.59 Cr I		11 d	4208.70 Tb I		4	4213.46 Nb I	
60	4203.72 Tb I		44	4208.89 Th II		28 cw	4213.50 Tb I	
440	4203.73 Tm I		55	4208.98 Zr II		4	4213.54 Y I	
10	4203.82 W I		9	4209.37 Cr I		16	4213.57 Pr II	
1.4	4203.99 Fe I		19	4209.41 Ce II		11	4213.86 Os I	
24	4204.04 La II		17	4209.70 Hf I		36	4213.86 Zr I	
7	4204.32 Nb I		3.5	4209.76 Cr I		10	4213.88 U	
13	4204.37 U II		18	4209.86 V I		1.8	4213.94 Sm II	
18	4204.41 W I		5	4210.00 Ce II		5	4213.96 Pr II	
3.5	4204.47 Cr I		4	4210.35 Fe I		26	4214.04 Ce II	
9	4204.52 Re I		45	4210.35 Sm II		6	4214.22 Nd II	
38	4204.70 Y II		6	4210.45 U		6	4214.28 U	
5	4204.74 Ce II		4	4210.77 Th I		7	4214.38 Dy I	
3.5	4204.82 Sm II		9	4210.92 Th II		28	4214.42 Tb II	
55	4204.86 Gd II		9 hs	4210.94 Ag I		6	4214.42 U II	
19	4205.03 Dy I		5	4211.02 Mo I		70	4214.44 Ru I	
4000 cw	4205.05 Eu II		280	4211.14 Rh I		2.0	4214.54 Th II	
4	4205.16 Ce		36	4211.23 Dy I		6	4214.60 Nd II	
7	4205.20 Sc I		28	4211.29 Nd II		36	4214.73 Nb I	
7	4205.25 Nd II		11	4211.30 Ho II		2.0	4214.83 Th I	
90	4205.31 Nb I		7	4211.34 Zr I		90	4215.02 Gd II	
10	4205.32 Er I		3.5	4211.35 Cr I		44	4215.13 Tb I	
28	4205.60 Nd II		18	4211.68 U II		300	4215.15 Dy I	
11	4205.78 Sm I		1300	4211.72 Dy I		9	4215.16 Os I	
2.5	4205.79 Ce II		3.0	4211.73 Ti I		12	4215.38 W I	
9	4205.81 Mo I		5	4211.75 Mn I		3200	4215.52 Sr II	
32	4205.88 Ta I		110	4211.86 Os I		16	4215.56 Rb I	
2.5	4205.89 Ce II		28	4211.86 Pr II		11 hc	4216.04 Pr	
16	4206.00 Tm I		18	4211.88 Zr II		7 h	4216.10 Sc I	
140	4206.02 Ru I		120	4212.00 Gd II		1.6	4216.19 Fe I	
9	4206.13 Nb I		9	4212.04 Nb I		3.5	4216.36 Cr I	
45	4206.13 Sm II		500	4212.06 Ru I		9 h	4216.67 Tb I	
13	4206.40 Ta I		10	4212.26 U II		7	4217.19 Pr	
55	4206.49 Tb I		6	4212.34 Sc I		60	4217.20 Gd II	
30	4206.54 Dy II		4	4212.49 Sc I		4	4217.23 Th II	
14	4206.58 Hf II		9	4212.53 Nb I		85	4217.27 Ru I	
6	4206.62 Rh I		7	4212.62 Zr I		7	4217.28 Nd II	
18	4206.62 Sm II		4	4212.75 Nd II		30	4217.56 La II	
3.5	4206.66 Th II		4	4212.79 Tm II		28	4217.56 Tb I	
220 c	4206.74 Pr II		280	4212.95 Pd I		22	4217.59 Ce II	
6	4206.80 Tb I		8	4213.02 Y I		7	4217.63 Cr I	
24	4207.05 W I		7	4213.04 Ce II		3.0	4217.76 Ir I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
16	4217.80 Y I		3.5	4222.41 Mo I		220	4227.04 Ho I	
28	4217.81 Pr		110	4222.60 Ce II		20	4227.14 Gd II	
44	4217.94 Nb I		28	4222.67 Tm I		5	4227.33 U II	
360	4218.09 Dy I		4	4222.68 Nb I		4	4227.39 Th I	
4	4218.19 Th II		9	4222.71 Tb I		6 h	4227.40 Eu II	
10 h	4218.26 Sc I		3.5	4222.73 Cr I		7	4227.41 Ce II	
110	4218.43 Er I		340	4222.98 Pr II		13	4227.43 Fe I	
11	4218.45 Zr I		4	4223.02 Gd II		360 c	4227.46 Re I	
4	4218.54 Th II		3.5	4223.18 Re I		4	4227.51 Nb I	
4	4218.55 Nd II		7	4223.21 Nd II		3.5	4227.65 Ti I	
6	4218.56 W I		7	4223.32 Tb II		26	4227.73 Nd II	
9 d	4218.56 Yb II		5	4223.47 Er I		4	4227.74 V I	
	4218.64 Yb I		32	4223.47 Ho I		55	4227.75 Ce II	
7	4218.63 Sm I		8	4223.51 Pr		180	4227.76 Zr I	
5	4218.71 V I		10	4223.70 Sm II		11	4228.03 Nd II	
9	4218.86 Tb I		5	4223.72 Er II		15	4228.08 Hf I	
10	4219.10 Ho I		8	4223.88 Ce II		11	4228.20 Nd II	
24	4219.17 Tb I		2.5	4223.88 Eu II		6	4228.30 Ce II	
3.5	4219.31 Sm I		5	4224.14 V I		8 c	4228.50 Pr	
7	4219.36 Fe I		3.5	4224.23 Sm II		10	4228.61 Ta I	
28	4219.38 W I		4	4224.25 Th II		6	4228.76 U	
4	4219.40 Mo I		8	4224.25 Y I		8 c	4229.10 Pr	
4	4219.56 Nd II		6	4224.27 Gd I		44	4229.15 Nb I	
14	4219.65 Pr II		24	4224.28 Tb I		17	4229.31 Ru I	
10 h	4219.73 Sc I		3.0	4224.55 Ce		5	4229.33 Eu II	
5	4219.98 U		6	4224.68 Dy I		7	4229.45 Th II	
4	4220.08 Th II		6	4224.76 W I		6	4229.50 Nd II	
8	4220.10 Tb II		3.5	4224.79 Ti I		44	4229.52 Ho II	
12	4220.14 Sm II		8	4224.84 Nd II		4	4229.69 V I	
17	4220.25 Nd II		30	4225.03 Gd I		50	4229.70 Sm II	
28 h	4220.63 Y I		10	4225.09 Ru I		20	4229.80 Gd II	
3.5	4220.65 Zr I		220	4225.14 Dy I		6	4229.80 Pr	
50	4220.66 Sm II		15	4225.15 Gd II		18	4229.83 Nb I	
34	4220.68 Ru I		340	4225.33 Pr II		6 h	4230.12 Ce II	
1.4	4220.80 Ir I		70	4225.33 Sm II		26	4230.20 Er II	
16	4220.99 Er I		6	4225.46 Zr I		2.5	4230.20 Rh I	
3.0	4221.08 Eu II		14 h	4225.54 Pr I		50	4230.31 Ru I	
65	4221.08 Re I		8 d	4225.59 Sc I		13	4230.32 Nb I	
360	4221.10 Dy I		450	4225.85 Gd I		6	4230.43 Th I	
10 h	4221.14 Nd I		10	4226.18 Sm I		8	4230.62 Tb I	
4	4221.17 Ce		8	4226.22 Nb I		8	4230.67 Pr I	
5	4221.41 Tb I		5	4226.34 W I		3.5	4230.73 Sm I	
3.5	4221.57 Cr I		44 cw	4226.45 Tb II		20	4230.95 La II	
3.5	4221.88 Sc I		5	4226.53 Os I		14 h	4231.24 Ho I	
6	4222.01 Dy		70	4226.57 Ge I		6	4231.34 Tb I	
12	4222.06 W I		9	4226.62 V I		3.5	4231.63 Zr II	
44	4222.22 Dy I		7	4226.66 Ru I		16	4231.67 U I	
4	4222.22 Fe I		1100	4226.73 Ca I		28	4231.75 Ce II	
32	4222.29 Ho I		6	4226.92 W I		24	4231.89 Tb I	
26	4222.36 U I		4	4226.99 Nd II		16	4231.93 Sc	

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18	4231.95	Nb I	9	4235.76	V I	4	4240.59	U II
7	4231.99	Yb I	8	4235.88	Gd II	5	4240.70	Cr I
55	4232.03	Dy I	17	4235.94	Fe I	18	4240.83	Mo I
5	4232.04	U II	6	4235.94	Ta II	85	4241.02	Pr II
7	4232.05	Ce	220	4235.94	Y I	70	4241.05	Ru I
17	4232.19	Tb II	14	4236.02	Ce II	9	4241.16	Re I
14	4232.32	Ru I	12	4236.04	U	70	4241.20	Zr I
75	4232.38	Nd II	18	4236.06	Zr I	8	4241.21	Nd II
15	4232.44	Hf II	28 c	4236.21	Pr II	9	4241.28	Gd II
5	4232.45	Eu II	4	4236.24	Re I	15 c	4241.30	Pr
28	4232.46	V I	6	4236.36	Ce II	15	4241.39	Re I
5	4232.47	Er I	6	4236.55	Zr I	9	4241.45	Nb I
7	4232.47	Gd II	12	4236.64	Pr II	32	4241.45	W I
10	4232.57	Ce II	10	4236.67	Ru I	75	4241.67	U II
140	4232.59	Mo I	80	4236.74	Sm II	110	4241.69	Zr I
44	4232.82	Tb I	7	4236.94	Tm II	6	4242.01	Ce II
6	4232.93	Gd I	6	4237.01	Pr I	220	4242.15	Tm II
3.5	4232.94	Ta I	5	4237.03	Er I	9	4242.56	Tb II
14	4232.95	V I	8	4237.16	Mo I	12	4242.63	Nb I
3.5	4232.96	Re I	9	4237.43	Zr I	28	4242.72	Ce II
6	4233.00	W I	6	4237.51	Eu II	3.5	4242.80	Mo I
28	4233.13	Pr II	34	4237.66	Sm II	70	4243.06	Ru I
6	4233.15	Nd	8	4237.81	Nb I	6	4243.43	Dy I
6	4233.20	Ce	9	4237.82	Sc	30	4243.53	Pr II
4	4233.29	Th I	11	4237.89	Ti I	6	4243.64	W I
15	4233.46	Os I	36	4238.05	Sc I	32	4243.78	Ho I
4	4233.49	Mo I	6	4238.35	Pr	6	4243.79	Ce I
11	4233.61	Fe I	160	4238.38	La II	17	4243.84	Gd II
18	4233.61	Sc I	3.0	4238.59	Re I	6	4243.93	Th II
1.0	4234.00	Co I	3.0	4238.69	Eu II	3.0	4243.99	Ta I
14	4234.00	V I	60	4238.78	Gd II	38	4244.37	U II
15	4234.19	Nd II	3.0	4238.82	Fe I	60	4244.37	W I
17	4234.21	Ce II	3.5	4238.96	Cr I	3.5	4244.44	Rh I
6	4234.22	Tb I	9 d	4239.07	Mo I	5	4244.56	Nd
16	4234.35	W I		4239.19	Mo I	42	4244.70	Sm II
4	4234.52	V I	15	4239.28	Tb I	3.0	4244.74	Eu I
42	4234.57	Sm II	180	4239.31	Zr I	10	4244.83	Ru I
14	4234.63	Zr I	8	4239.57	Sc I	5	4244.96	Nd II
6	4234.73	Ce II	14	4239.72	Mn I	9	4245.14	Tb I
11	4234.76	Er II	17	4239.84	Nd II	7	4245.16	Hf I
6	4234.83	Dy I	55	4239.85	Dy I	8	4245.18	Sm II
3.5	4235.03	Mo I	70	4239.91	Ce II	14	4245.34	Gd I
5	4235.07	Gd II	9	4239.91	Tb I	14	4245.35	Ta I
28	4235.14	Mn I	24	4240.03	Pr II	10	4245.40	Ho II
6	4235.17	Er I	13	4240.08	Mo I	6	4245.46	Pr
17 h	4235.24	Nd II	13	4240.28	Mo I	3.5	4245.84	Hf II
38	4235.29	Mn I	70	4240.34	Zr I	22	4245.88	Ce II
28	4235.35	Tb I	4	4240.36	V I	36	4245.92	Dy I
6	4235.46	Th I	3.0	4240.45	Sm I	22	4245.98	Ce II
60	4235.73	Y II	3.5	4240.59	Th II	18	4246.02	Mo I

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
9	4246.12 Sc I		160	4251.73 Gd II		26 c	4257.60 Re I	
6	4246.15 Pr		17	4251.78 Sm II		22	4257.66 Mn I	
19	4246.26 U I		4	4251.86 Ce II		10	4257.79 Nd II	
13	4246.30 Nb I		16	4251.87 Mo I		16	4258.04 Zr II	
17	4246.33 Ru I		16	4251.93 Er II		7	4258.14 Dy I	
6	4246.40 Ce		11 bl	4252.08 Hf HfO		44	4258.23 Tb I	
4	4246.40 Tm II		2.5	4252.31 Co I		6	4258.53 W I	
19	4246.57 Gd II		12	4252.43 U		6	4258.54 Ti I	
12	4246.59 Tb I		50	4252.44 Nd II		14	4258.58 Sm II	
28	4246.71 Ce II		9	4252.70 Tb I		14 c	4258.61 Ho II	
34	4246.73 Ru I		7 h	4252.88 Nd		3.5	4125.78 Ce II	
7	4246.82 Re I		17	4252.97 Nb I		9	4258.91 Nb I	
1400	4246.83 Sc II		6	4253.03 Pr I		28	4258.99 Ru I	
7	4246.88 Nd II		28	4253.36 Ce II		8	4259.11 Ir I	
3.0	4247.06 Eu II		80	4253.37 Gd II		9	4259.31 V I	
11	4247.36 Dy II		8	4253.53 Th I		32	4259.36 W I	
120	4247.38 Nd II		7	4253.57 Zr I		3.5	4259.39 Sm II	
3.5	4247.39 Sm II		60	4253.61 Gd II		4	4259.62 Nd II	
3.0	4247.43 Fe I		15	4253.70 Nb I		9	4259.75 Ce II	
5	4247.45 Ce II		4	4253.72 Sm II		6	4259.94 W I	
2.0	4247.60 Th II		3.0	4253.80 Eu II		7	4260.00 Ru I	
75 c	4247.66 Pr II		6	4253.87 Nd II		75	4260.12 Gd I	
10	4248.00 Th II		6	4254.04 Tb I		22	4260.29 W I	
5	4248.09 Ce II		17	4254.29 Nd		8	4260.34 Th I	
3.5	4248.14 Ru I		1700	4254.35 Cr I		9	4260.36 Mo I	
5	4248.15 Nd		44	4254.42 Pr II		36	4260.48 Fe I	
6	4248.44 Dy II		140 cw	4254.43 Ho I		4	4260.66 Mo I	
6	4248.57 Tb II		13	4254.69 Nb I		440	4260.85 Os I	
3.0	4248.66 Nb I		5	4254.70 Ce II		15	4260.98 Hf I	
75	4248.68 Ce II		13	4254.96 Mo I		8	4261.16 Ce II	
8	4249.08 Pr II		34	4255.25 Tb I		7	4261.21 Zr I	
7	4249.12 Ti I		26	4255.44 Nb I		5	4261.35 Cr I	
13	4249.46 Nb I		6	4255.50 Cr I		7	4261.42 Zr I	
6	4249.46 W I		4	4255.75 Re I		3.0	4261.44 Mo I	
8	4249.48 Pr II		44	4255.78 Ce II		6	4261.60 Ti I	
14	4249.55 Sm II		4	4255.94 Nb I		9	4261.71 Nb I	
4	4249.68 Th II		11	4256.04 Ti I		12 c	4261.80 Pr II	
14	4249.99 La II		5	4256.09 Th II		24	4261.84 Nd II	
12	4250.13 Fe I		9	4256.12 Tb I		5	4261.84 Tb I	
5	4250.26 Tb II		12	4256.16 Ce II		80	4262.05 Nb I	
6	4250.28 Gd I		4	4256.24 Nd II		150	4262.09 Gd I, II	
12	4250.31 Th II		5	4256.25 Th I		9	4262.16 V I	
17	4250.40 Pr II		36	4256.33 Dy II		9	4262.24 Nd II	
2.5	4250.66 Ce II		140	4256.39 Sm II		17	4262.31 Pr II	
24	4250.79 Fe I		7	4256.44 Zr I		5	4262.34 La I	
30	4251.20 Y I		6	4256.47 Nd I		2.0	4262.61 Th I	
12	4251.33 Tb I		6	4256.82 Nd II		85	4262.68 Sm II	
14 c	4251.49 Pr II		8	4257.12 Ce II		8	4262.80 Pr	
4	4251.60 Ce II		8	4257.37 V I		28	4263.13 Ti I	
12	4251.72 Tb II		7	4257.50 Th I		9	4263.14 Cr I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
8	4263.15	Pr	9	4268.67	Nb I	20	4273.36	Th II
22	4263.32	W I	15	4268.73	Gd II	5	4273.43	Rh I
4	4263.36	Th II	6	4268.85	U	9	4273.44	Ce II
18	4263.39	Hf I	28	4269.10	Pr II	7	4273.52	Zr II
3.0	4263.40	Ru I	10	4269.25	Ce II	11	4273.63	Ho II
14	4263.43	Ce II	26	4269.28	Mo I	6	4273.69	W I
9	4263.44	Nd II	150	4269.39	W I	6	4273.98	U II
32	4263.59	La II	48	4269.50	La II	8	4274.02	Th II
5	4263.64	Er I	11	4269.61	Os I	28	4274.17	Gd I
24	4263.66	Tb I	12	4269.61	U II	24	4274.55	W I
24 c	4263.81	Pr II	30	4269.69	Tb I	20	4274.58	Ti I
9 h	4263.91	Nd	4	4269.76	V I	8	4274.69	Nb I
	4264.00	Nd	2.5	4269.77	Sm II	8	4274.77	Zr I
5	4263.95	Ce II	12	4269.78	W I	1300	4274.80	Cr I
55	4264.05	Ho I	5	4269.93	Er I	20	4275.09	Nd II
12	4264.37	Ce II	2.0	4269.94	Th I	4	4275.11	Cu I
6	4264.72	Tb I	6	4270.14	Ti I	8 c	4275.17	Pr
9	4264.75	Os I	44	4270.19	Ce II		4275.32	Pr
5	4264.85	Er I	2.0	4270.24	Eu II	20	4275.21	Tb I
7	4264.98	Tb I	5	4270.28	Gd I	18	4275.49	W I
34	4265.08	Sm II	4	4270.32	V I	15	4275.56	Ce II
4 h	4265.17	V I	4	4270.33	Th II	24	4275.64	La II
3.0	4265.30	Ir I	14	4270.56	Nd II	8	4275.82	Pr
7	4265.61	Ru I	30	4270.69	Nb I	11	4276.19	Pr
3.0	4265.71	Ti I	28	4270.72	Ce II	10	4276.43	Ti I
22	4265.92	Mn I	3.5	4270.73	Sm II	11	4276.45	Er II
44	4266.02	Nb I	10	4270.84	Sm II	6	4276.47	U
34	4266.04	Ho I	2.5	4271.06	Cr I	11	4276.72	Zr I
9	4266.18	Mo I	3.5	4271.09	Th II	20	4276.74	Dy I
3.5	4266.22	Ti I	12	4271.16	Fe I	10 d	4276.75	Tb II
8	4266.31	Sm I	7	4271.51	Ta I	18	4276.75	W I
4	4266.32	U I	36	4271.55	V I	7	4276.81	Th II
60	4266.34	Tb I	9	4271.63	Tb I	85	4276.91	Mo I
6	4266.54	W I	20	4271.71	Tm I	4	4276.96	Th II
60	4266.60	Gd I	100	4271.76	Fe I	36	4276.96	V I
20	4266.71	Nd II	14	4271.76	Pr II	5	4277.15	Os I
44	4267.00	Gd I	3.5	4271.86	Sm I	110	4277.24	Mo I
7	4267.22	Ce	3.5	4272.01	Sm II	3.0	4277.26	Ru I
10	4267.30	U II	3.0	4272.06	Mo I	8	4277.29	Nd II
9	4267.78	Pr	9	4272.21	Tb I	34	4277.31	Th II
6	4267.90	Dy I	70 c	4272.27	Pr II	16	4277.50	Lu I
4	4267.94	U	7	4272.43	Ti I	13	4277.50	Nb I
28	4268.02	Zr I	20	4272.79	Nd II	4	4277.73	Yb I
7	4268.08	Mo I	15	4272.85	Hf II	9	4277.77	Tb I
28	4268.10	Ir I	4	4272.86	Th I	11	4278.04	Pr
14	4268.26	Ta I	3.5	4272.91	Cr I	5 h	4278.22	Gd II
6	4268.29	Dy I	3.5	4272.97	Nb I	10	4278.23	Ti I
4	4268.30	Ce II	12	4273.07	Mo I	3.0	4278.25	Ce II
5	4268.56	Tm I	5 h	4273.29	Gd I	5	4278.32	Th I
44	4268.64	V I	3.0	4273.36	Nb I	70 cw	4278.52	Tb II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
5	4278.60 Rh I		16	4283.50 Sm I		14	4288.67 Ce II	
3.5	4278.69 Ru I		8	4283.52 Th II		70	4288.71 Rh I	
2.5	4278.81 Ti I		5	4283.56 Sc		15	4288.84 U I	
14	4278.87 Ce II		34	4284.06 V I		80	4289.07 Ti I	
8	4278.99 Pr		5	4284.08 Mn I		22	4289.36 Ca I	
10	4279.06 Ta I		70	4284.33 Ru I		13	4289.42 Mo I	
8	4279.50 Nb I		42	4284.52 Nd II		7	4289.42 Pr	
80	4279.68 Sm II		2.5	4284.53 Sm II		20	4289.44 Nb I	
	4279.75 Sm II		9	4284.58 Ho II		14	4289.45 Ce II	
4	4279.71 Nb I		8 h	4284.60 Mo I		850	4289.72 Cr I	
7	4279.76 Dy I		5	4284.96 W I		28	4289.72 Tb I	
16	4279.94 Sm II		5	4284.97 Th II		5	4289.88 Gd II	
42 c	4280.11 Pr II		13	4284.99 Ti I		11	4289.89 Pr	
10	4280.14 Ce II		28	4285.13 Tb II		140	4289.94 Ce II	
4	4280.17 Nd		20	4285.37 Ce II		10	4290.18 Ho II	
30	4280.27 La I		3.5	4285.50 Sm II		4 h	4290.18 Mo I	
6	4280.32 Sm II		4	4285.54 Pr		10	4290.23 Ti II	
7	4280.40 Cr I		6	4285.75 Tb II		5	4290.40 Pr	
85	4280.49 Gd II		1.0	4285.79 Co I		70	4290.94 Ti I	
2.0	4280.57 Th I		40	4285.82 Gd I		7	4290.96 Nd II	
17	4280.60 Nb I		9	4285.90 Os I		5	4290.99 Pr II	
150	4280.79 Sm II		75	4286.01 Ti I		10	4291.14 Ti I	
8	4281.00 Ce II		12	4286.01 W I		12 c	4291.17 Re I	
13	4281.01 Sm II		28	4286.12 Gd I		15	4291.19 Nb I	
26	4281.03 Lu I		6	4286.13 Tb II		4	4291.20 Mo I	
9	4281.07 Th II		3.5	4286.21 Th		10	4291.20 Zr I	
20	4281.10 Mn I		8	4286.22 Nb I		3.0	4291.30 V I	
6	4281.16 Ce II		7	4286.38 Ta I		10	4291.35 Zr I	
9	4281.38 Ti I		4	4286.42 V I		2.5	4291.62 Sm II	
8	4281.41 Th II		3.5	4286.51 Zr II		7 h	4291.63 Pr	
4	4281.83 Mo I		55	4286.56 Er I		8	4291.65 Re I	
4.0	4281.93 Ru I		2.5	4286.62 Ir I		4	4291.81 Th I	
15	4282.03 U II		24	4286.64 Sm II		26	4291.82 V I	
7	4282.03 Zr I		11	4286.91 Tb II		10	4291.94 Dy I	
50	4282.04 Th II		60	4286.97 La II		3.5	4291.96 Cr I	
50	4282.20 Zr I		4	4286.98 Pr		8	4292.04 Nb I	
48	4282.21 Sm I		42	4286.99 Nb I		65	4292.13 Mo I	
7	4282.22 Ru I		17	4287.05 Ru I		24	4292.18 Sm II	
12	4282.34 W I		11	4287.08 Mo I		15	4292.48 Nb I	
8	4282.41 Fe I		14	4287.11 Tb I		8	4292.58 Ce II	
28	4282.44 Nd II		70	4287.40 Ti I		8	4292.77 Ce II	
70 c	4282.44 Pr II		3.5	4287.81 V I		6 h	4293.13 Tb I	
12	4282.45 U II		15	4287.87 U II		10 c	4293.14 Pr II	
14	4282.57 Nd II		4	4288.05 Th II		85	4293.21 Mo I	
18	4282.71 Ti I		2.5	4288.16 Ti I		20	4293.28 Ru I	
4	4282.79 Gd II		4 c	4288.46 Pr		12	4293.58 Pr II	
32	4282.83 Sm I		2.0	4288.48 Th I		34	4293.88 Mo I	
3.5	4282.91 V I		5	4288.50 Er I		50	4293.95 Os I	
24	4283.01 Ca I		130	4288.64 Mo I		6 h	4294.04 Tb I	
20	4283.10 Ba I		2.0	4288.66 Th I		12	4294.10 W I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
12	4294.12 Ti II		11	4298.37 Tm I		28	4302.89 Zr I	
14	4294.13 Fe I		4	4298.43 Gd II		22	4302.94 Tb I	
5 h	4294.19 Nd		10 c	4298.47 Ho II		17 c	4302.98 Ta I	
6	4294.36 Ta I		170	4298.66 Ti I		320	4303.58 Nd II	
450	4294.61 W I		10	4298.73 Eu I		26	4303.59 Pr II	
14 c	4294.70 Pr II		5	4298.84 Th II		11	4303.81 Er II	
5	4294.76 Ce II		6	4298.90 Dy I		3.0	4303.88 Nb I	
26	4294.77 Sc II		3.0	4298.90 Mo I		11	4304.00 Tb I	
28	4294.79 Hf I		26	4298.91 Er I		6	4304.27 Tb I	
24	4294.79 Ru I		40 c	4298.92 Pr II		8	4304.28 Ce	
50	4294.79 Zr I		20	4298.99 Ca I		20	4304.40 Re I	
30 d	4294.94 Dy II		5	4299.09 Ce II		20	4304.45 Nd II	
	4295.04 Dy I		6	4299.14 Sm I		17	4304.68 Zr I	
6	4295.04 Th II		10	4299.15 Ho I		11	4304.72 Ce II	
8	4295.11 Pr		17	4299.23 Ti I		12	4304.90 Gd II	
14	4295.34 Tb I		12	4299.24 Fe I		4	4304.92 Mo I	
11	4295.62 Nb I		40	4299.29 Gd I		22	4304.94 Sm II	
4	4295.74 Sm II		6	4299.34 Sm II		30	4305.14 Ce II	
7	4295.76 Cr I		42	4299.36 Ce II		2.5	4305.45 Cr I	
70	4295.76 Ti I		60	4299.60 Nb I		34	4305.45 Sr II	
50	4295.93 Ru I		17	4299.64 Ti I		4	4305.48 Nd II	
34 d	4295.97 Lu I		5	4299.71 Nd II		32	4305.71 Sc II	
	4296.09 Lu I		6	4299.84 Th I		130	4305.76 Pr II	
60	4296.05 La II		28	4299.90 Tb I		500	4305.92 Ti I	
14	4296.07 Ce II		3.0	4299.92 Re I		7	4305.96 Yb I	
50	4296.08 Gd II		17	4300.05 Ti II		10	4306.08 Pr	
17	4296.11 V I		55	4300.33 Ce II		13	4306.21 V I	
4	4296.16 Mo I		12	4300.44 La II		8	4306.28 Nb I	
12	4296.16 Nb I		3.0	4300.51 Cr I		5	4306.34 Er I	
6	4296.22 Os I		240	4300.56 Ti I		100	4306.34 Gd I	
13	4296.30 Gd II		3.0	4300.86 Ce		4	4306.37 Th II	
8	4296.34 Tb I		60	4300.99 Nb I		55	4306.72 Ce II	
3.0	4296.37 Ce II		10	4301.09 Ho II		7	4306.75 Nd II	
7	4296.41 Hf I		340	4301.09 Ti I		4	4306.78 U	
3.0	4296.62 Mo I		6	4301.15 Tb I		18	4306.88 W I	
140	4296.67 Ce II		4	4301.18 Cr I		7	4307.18 Th I	
110	4296.74 Sm I		4	4301.22 Nd I		11	4307.18 V I	
3.5	4296.74 Zr II		5	4301.26 Er I		22	4307.21 Tb I	
6	4296.77 Rh I		3.0	4301.26 Mo I		85	4307.60 Ru I	
11	4297.11 U II		3.0	4301.28 Sm I		12	4307.64 W I	
20	4297.17 Gd II		9	4301.47 U II		4	4307.67 Pr	
4	4297.30 Th I		8	4301.60 Ir I		26	4307.74 Ca I	
4	4297.36 Nd II		26	4301.61 Er II		12	4307.78 Nd II	
13	4297.68 V I		7	4301.93 Ti II		3.0	4307.87 Gd II	
340	4297.71 Ru I		9 c	4302.10 Pr II		15	4307.90 Ti II	
6	4297.74 Cr I		240	4302.11 W I		100	4307.91 Fe I	
100	4297.76 Pr II		36 h	4302.30 Y I		4	4308.12 Nb I	
16	4297.80 Nd II		110	4302.53 Ca I		2.0	4308.12 Th I	
13	4298.03 V I		6	4302.65 Ce II		3.0	4308.50 Ti I	
34	4298.37 Tb I		6	4302.72 Dy II		85	4308.67 Dy II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
14 d	4308.68	Tb II	11 h	4313.43	Tb I	7	4318.81	Ta I
8	4308.69	Nb I	12	4313.73	Sm II	200	4318.85	Tb I
5	4308.88	Os I	170	4313.84	Gd I	130	4318.94	Sm II
9 c	4308.89	Pr	4	4313.88	Nb I	10	4319.00	Pr II
60	4309.01	Sm II	9	4313.88	U	7	4319.05	Zr I
3.5	4309.21	Ru I	3.0	4313.89	V I	2.0	4319.09	Th
24	4309.29	Gd I	5	4313.90	Dy I	4	4319.53	Re I
12	4309.56	Nb I	380	4314.09	Sc II	32	4319.53	Sm I
16	4309.57	Lu I	10	4314.30	Ru I	3.0	4319.64	Cr I
8	4309.58	Ce II	7	4314.35	Ti I	3	4319.78	U
280	4309.63	Y II	10	4314.38	Nd II	50	4319.87	Ru I
28	4309.74	Ce II	48	4314.40	Gd I	9	4319.94	Er II
13	4309.80	V I	28	4314.52	Nd II	10	4320.12	Th II
3.5	4309.82	Zr I	10	4314.52	Ta I	5 h	4320.17	Pr
14	4309.99	Th II	3.0	4314.58	Re I	14	4320.26	Tb I
8	4310.39	Mo I	100	4314.80	Ti I	34	4320.52	Gd I
4	4310.39	U II	4	4314.93	Ce II	3.5	4320.58	Ru I
42	4310.44	Tb I	10	4315.03	Ho II	6	4320.58	Th II
6	4310.51	Nd II	2.0	4315.09	Au I	7	4320.67	Hf II
6	4310.59	Ir I	6	4315.09	Fe I	40	4320.72	Ce II
11	4310.70	Ce II	4	4315.25	Th I	300	4320.74	Sc II
7	4310.96	Tb II	5 d	4315.35	Sm II	70	4321.11	Gd II
8	4310.98	Gd II		4315.38	Sm II		4321.20	Gd I
22	4311.04	Ho I	7	4315.41	Ce II	7	4321.17	Zr I
7	4311.10	Pr II	7	4315.52	Pr	3.0	4321.30	Ru I
5	4311.25	Nd I	14	4315.73	Tb I	5	4321.49	Tb I
40	4311.27	Nb I	5	4315.90	La II	15	4321.66	Ti I
	4311.39	Nb I	48	4316.05	Gd II	7	4321.97	Mo I
8	4311.29	Tb I	7	4316.06	Pr	12	4322.20	Gd II
50	4311.40	Os I	6	4316.27	Gd II	55	4322.24	Tb I
24	4311.50	Ir I	5	4316.30	Y I	44	4322.51	La II
28	4311.56	Tb I	4	4316.48	Nb I	6	4322.55	Dy II
2.0	4311.58	Th I	7	4316.64	Ru I	7	4322.68	Ta I
8	4311.59	Ce II	6	4316.81	W I	16	4322.87	Tb I
3.5	4311.65	Ti I	4	4316.96	Yb II	3.0	4322.96	Ru I
7	4311.70	Nb I	4	4317.05	Pr	40	4323.28	Sm II
2.0	4311.80	Th I	7	4317.31	Zr II	3.0	4323.47	Nb I
4	4311.92	Pr	10	4317.33	Ce II	19	4323.55	Pr II
10	4312.08	Tb II	8	4317.84	Pr II	8 d	4323.66	Tb II
12	4312.45	Nb I	16	4317.93	Mo I	10	4324.03	Zr I
5	4312.55	Mn I	4	4317.99	Ce	12	4324.06	Gd II
4	4312.80	Mo I	4	4318.01	Nb I	16	4324.46	Sm I
16	4312.85	Sm I	11	4318.14	Hf I	5	4324.60	Ce I
7	4312.87	Ti II	8 d	4318.29	Th II	11	4324.79	Ce II
4	4312.97	Mo I		4318.42	Th I	220	4325.01	Sc II
10	4312.99	Th I	7	4318.40	Tm I	16	4325.05	Ru I
2.5	4313.10	Ce II	34	4318.43	Ru I	5	4325.08	Cr I
11	4313.13	U I	8	4318.58	Re I	16	4325.13	Ti I
34	4313.25	Tb I	30	4318.64	Ti I	11	4325.14	Dy II
5	4313.36	Nd II	40	4318.65	Ca I	16	4325.44	Zr I

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
11	4325.50 Tb I		14	4330.27 Hf I		12	4335.70 Th II	
240 d	4325.57 Gd II		8	4330.31 Tb I		9	4335.73 U I	
	4325.69 Gd I		5	4330.44 Pr		18	4335.75 Pr	
95	4325.76 Fe I		22	4330.45 Ce II		60	4336.14 Sm I	
65	4325.76 Nd II		4	4330.61 Eu II		3.5	4336.20 Ta I	
55	4325.83 Tb II		32	4330.61 Gd II		28	4336.26 Ce II	
26	4325.88 Dy I		28	4330.64 Ho II		7	4336.42 Ru I	
5	4325.90 U		9	4330.66 W I		80	4336.50 Tb I	
80	4326.14 Mo I		11	4330.78 Y I		3.5 d	4336.63 Gd I	
8	4326.14 Tb I		2.0	4330.84 Th I			4336.78 Gd I	
10	4326.25 Os I		9	4330.97 W I		16	4336.66 Hf II	
4	4326.32 Gd II		9	4331.16 Ru I		3.0	4336.78 Sm	
36	4326.33 Nb I		2.5	4331.18 Eu I		4	4337.05 Fe I	
13	4326.36 Ti I		1.0	4331.24 Co I		34	4337.13 Ho II	
8	4326.39 Dy I		5	4331.29 Pr		16	4337.27 Ru I	
280	4326.47 Tb I		9	4331.35 Er I		9	4337.28 Th I	
24	4326.74 Mo I		40	4331.37 Nb I		3.0	4337.29 Y I	
16	4326.82 Ru I		22	4331.38 Gd I		13	4337.51 Gd I, II	
5	4326.83 Ce II		8	4331.45 Sm I		3.0	4337.56 Nb I	
1.8	4327.06 Pt I		11	4331.76 Ce II		65	4337.57 Cr I	
180	4327.12 Gd I, II		4	4331.92 Th II		55	4337.64 Tb I	
6 d	4327.14 Th		55	4332.12 Tb I		6	4337.68 Eu I	
12	4327.38 Nb I		12	4332.13 W I		70	4337.78 Ce II	
6	4327.41 W I		20	4332.25 Re I		13	4337.92 Ti II	
10	4327.43 Ru I		3.5	4332.50 Ru I		3.5	4338.10 Th I	
3.0	4327.51 Sm II		4	4332.51 Mo I		160	4338.45 Tb I	
30	4327.93 Nd II		9 c	4332.55 Ho II		3.0	4338.68 Ru I	
5	4328.20 Pr		22	4332.71 Ce II		32	4338.69 Pr II	
16	4328.42 Pr		8	4332.72 Lu I		3.0	4338.70 Nb I	
10	4328.43 Nb I		40	4332.82 V I		32	4338.70 Nd II	
30	4328.68 Os I		5	4333.15 Pr		4	4338.71 Mo I	
4	4328.68 Th II		7	4333.24 Gd I		9	4338.75 Os I	
10	4328.81 Er I		3.5	4333.26 Zr II		6	4338.96 Sm I	
10	4328.90 Dy II		5	4333.73 Tb I		4	4338.99 Er II	
11	4328.94 Gd I		460	4333.74 La II		24	4339.32 Ce II	
22	4328.95 Tb I		120	4333.91 Pr II		95	4339.45 Cr I	
14	4328.99 Pr II		2.0	4333.93 Th II		2.0	4339.62 Co I	
120	4329.02 Sm II		3.0	4334.09 V I		14	4339.62 Tb I	
6	4329.36 Eu I		90	4334.15 Sm II		13	4339.68 Dy II	
24	4329.42 Pr II		8	4334.62 Pr II		6	4339.68 Pr	
4	4329.49 Th II		3.5	4334.64 Hf II		32	4339.72 Cr I	
3.5	4329.56 Zr I		14	4334.68 Tb I		4	4339.82 Mo I	
9	4329.57 Ta I		11	4334.81 Mo I		8	4339.87 Tb I	
34	4329.58 Gd I		2.5	4334.84 Ti I		2.5	4339.92 Sm I	
3.0	4329.63 Mo I		5	4334.87 Ce II		5	4340.13 Cr I	
8	4329.73 Nb I		2.0	4334.96 La II		4.0	4340.34 Ru I	
5	4329.97 Eu I		5	4335.03 Er I		5	4340.56 Ce II	
30	4330.02 Sm I		3.5	4335.29 Gd II		3.5	4340.60 Gd I	
36	4330.02 V I		2.0	4335.32 Th I		65	4340.62 Tb I	
4	4330.27 Er II		4	4335.49 Ce II		4	4340.73 La I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
8	4340.75	Mo I	5	4346.43	Ce	4	4351.00	Tm II
4 d	4340.89	Th I	5	4346.43	Th I	32	4351.05	Cr I
	4341.02	Th II	200	4346.46	Gd I	3.5 h	4351.15	Hf I
11	4340.92	Er I	10	4346.48	Ru I	7	4351.18	Tm II
10	4341.00	Tb I	5	4346.48	Tm I	40	4351.29	Nd II
60	4341.01	V I	6	4346.49	Sm II	2.0	4351.30	Ir I
3.5	4341.04	Ru I	5	4346.49	Tb I	9	4351.53	Os I
50	4341.13	Zr I	6	4346.52	Zr I	3.0	4351.55	Mo I
42	4341.28	Gd II	85	4346.62	Gd I	30	4351.57	Nb I
12	4341.42	Mo I	6	4346.83	Cr I	5	4351.60	Tb II
50	4341.69	U II	11 cw	4346.84	Ho II	4	4351.63	Er I
3.0	4341.98	Lu II	4	4346.89	Pr	190	4351.77	Cr I
8	4342.07	Nd II	11	4347.00	W I	100	4351.85	Pr II
50	4342.07	Ru I	11	4347.19	U II	38	4352.10	Sm II
4	4342.14	Ce II	3.5	4347.22	Th II	6	4352.33	Y I
85	4342.18	Gd II	3.0	4347.22	Zr I	2.0	4352.56	Ir I
6	4342.26	Th II	20	4347.31	Gd II	7	4352.57	Hf I
2.5 h	4342.38	Sm II	4	4347.31	Nb I	6	4352.67	Th I
2.0	4342.44	Rh I	42 c	4347.49	Pr II	6	4352.70	Y I
5	4342.44	Th I	5	4347.51	W I	40	4352.71	Ce II
5	4342.49	Ce II	4 h	4347.60	Ce II	4	4352.74	Fe I
40 cw	4342.53	Tb I		4347.71	Ce II	80	4352.87	V I
7 c	4342.81	Pr	13	4347.69	Dy I	40 d	4353.20	Tb II
14	4342.82	Nb I	75	4347.80	Sm II	6	4353.27	Nb I
4	4342.83	V I	95	4347.89	Zr I	7	4353.31	Mo I
3.5	4343.04	Zr I	6	4348.12	W I	6	4353.34	Hf I
4	4343.50	Nd I	15	4348.33	Er I	12	4353.37	Ce I, II
4	4343.56	Ce I	2.5	4348.53	Sc I	6	4353.39	Th II
5 h	4343.85	Tb I	4	4348.59	Th I	7	4353.79	Gd I
4	4343.89	Pr	14	4348.65	Nb I	3.0	4354.06	Gd II
7	4343.94	Th II	44 h	4348.79	Y I	3.0	4354.06	Ti I
4	4344.21	Tb II	3.0	4348.93	Zr I	65	4354.13	Ru I
2.0	4344.29	Ti II	11	4349.03	Nb I	3.0	4354.19	Nb I
95	4344.30	Gd II	4	4349.07	Th I	55	4354.40	La II
9	4344.31	Ta I	5	4349.10	Nd	6 h	4354.46	Os I
9	4344.32	Th II	10	4349.61	Tb I	4	4354.48	Th I
55 cw	4344.33	Pr II	32	4349.70	Ru I	10	4354.55	U
5	4344.48	Tm I	3.0 h	4349.74	Hf I	16	4354.61	Sc II
160	4344.51	Cr I	50	4349.79	Ce II	6	4354.80	La I
12	4344.60	Th	4	4350.21	Nd II	13	4354.80	Ru I
6	4344.65	Y I	4	4350.30	Nb I	40	4354.91	Pr II
3.0	4344.66	Mo I	7 h	4350.33	Ba I	10	4354.98	V I
10	4345.32	Nb I	22	4350.34	Mo I	16	4355.09	Eu II
16 d	4345.83	Ce II	30	4350.40	Pr II	12	4355.14	Ta I
	4345.96	Ce II	38	4350.46	Sm II	17	4355.16	W I
5	4345.84	W I	13	4350.51	Hf II	4	4355.19	Pr
38	4345.86	Sm II	140	4350.73	Ho I	8	4355.32	Th II
6	4346.11	Ti I	5 h	4350.75	Tb I	32 h	4355.75	U I
4	4346.12	Nb I	1.6	4350.82	Sm I	12	4355.94	V I
5 d	4346.33	Dy II	10 h	4350.82	Th II	9	4356.02	Nd II

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
26	4356.09 Tb I		4	4361.26 Pr		20	4367.30 Tb I	
22	4356.33 Hf I		6	4361.30 Th II		5	4367.56 Ce II	
32	4356.73 Ho II		2.5	4361.35 Ce		19	4367.58 Re I	
2.5	4356.75 Ce II		5	4361.39 Dy II		4	4367.89 Tm II	
80	4356.84 Tb I		3 h	4361.40 Nd		10	4367.90 Hf II	
3.0	4356.85 Nb I		1.8	4361.57 Eu II		4.0	4367.97 Nb II	
5	4356.99 Hf I		3.5	4361.65 Nb I		34	4368.03 Sm II	
4	4357.34 Mo I		9	4361.66 Ce II		12	4368.04 V I	
4	4357.47 Tb I		4	4361.82 Pr		6	4368.23 Ce II	
4	4357.50 Pr		11	4361.82 W I		110	4368.33 Pr II	
4	4357.61 Th II		4	4362.02 Mo I		22	4368.43 Nb I	
12	4357.73 Y I		55	4362.04 Sm II		4	4368.60 V I	
1.6	4357.90 Sm I		32	4362.05 U I		20	4368.64 Nd II	
4	4357.91 Ce		14	4362.26 U II		2.0	4368.94 Ti I	
4	4357.98 Os I		5 w	4362.44 Tb I		22	4369.04 Mo I	
4	4357.98 Re II		4	4362.71 Mo I		15	4369.15 Gd I	
6	4358.14 Os I		30	4362.91 Sm I		5	4369.24 Ce	
50	4358.17 Nd II		5	4362.93 U II		6	4369.30 Th II	
4	4358.31 Th I		9	4362.98 Pr II		6	4369.35 Ta I	
400	4358.35 Hg I		6	4363.13 Cr I		9	4369.38 Er II	
16	4358.46 Dy II		9	4363.22 Pr II		3.5	4369.47 Eu II	
10	4358.64 Sc I		4 d	4363.39 Ce II		2.5	4369.62 Nb I	
38	4358.69 Re I			4363.49 Ce II		8	4369.68 Ti I	
5	4358.70 Nd II		15	4363.45 Sm II		28	4369.77 Gd II	
80	4358.73 Y II		4	4363.52 V I		1.4	4369.77 Fe I	
6	4358.74 Zr I		7	4363.66 Tm II		14	4369.92 Sm II	
7	4359.07 Ce		16	4363.93 Ho II		18	4370.18 Gd I	
5	4359.08 Sc		1.6	4364.05 Sm II		6	4370.36 Nb I	
12	4359.11 Pr II		7	4364.14 Nd II		3.0	4370.42 Ru I	
5	4359.15 Gd II		8	4364.22 Dy II		3.0	4370.48 Sm II	
4	4359.25 Nd II		4	4364.22 V I		10	4370.66 Os I	
6	4359.37 Th I		8	4364.47 Mo I		8	4370.80 Pr II	
3.0	4359.62 Mo I		65	4364.66 Ce II		12	4370.95 Zr II	
48	4359.63 Cr I		11	4364.67 La II		16	4370.97 Hf II	
3.0	4359.64 Gd II		17	4364.79 W I		1.0	4371.13 Co I	
26	4359.74 Zr II		5	4364.84 Ta I		6	4371.20 Ru I	
36 c	4359.80 Pr II		2.5	4364.92 Sc		44	4371.28 Cr I	
7 c	4359.85 Nb I		6	4365.37 Hf I		8	4371.43 Ho II	
200	4359.93 Tm I		19	4365.67 Os I		28	4371.61 Pr II	
26	4360.16 Tb I		6	4365.93 Th I		7	4371.76 U I	
7	4360.18 Ce II		3.0	4365.95 Sm I		11 bl	4371.97 La	LaO
5	4360.44 Ce II		11 d	4365.96 W I		20	4372.05 Tb I	
8	4360.49 Ti I			4366.07 W I		3.5	4372.14 Nd II	
38	4360.72 Sm II		4	4366.00 Tb II		3.0 h	4372.20 Eu II	
28	4360.81 Zr I		12	4366.03 Y I		220	4372.21 Ru I	
5	4360.83 Ta I		14	4366.38 Nd II		3.5	4372.28 Nd II	
4	4360.87 Nd II		32	4366.45 Zr I		5	4372.38 Ti I	
15	4360.92 Gd II		7	4366.54 Mo I		7	4372.40 Ce II	
15	4361.07 Sm II		13	4366.73 Dy I		17	4372.53 W I	
80	4361.21 Ru I		7	4367.00 Ce II		12	4372.57 U II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
3.5 h	4372.73 Nd II		4	4376.90 Os I		4	4383.27 U I	
5	4372.76 U I		3.5	4377.40 Nd II		9	4383.36 Ru I	
4	4373.04 Rh I		14	4377.96 Nb I		28	4383.44 La II	
3	4373.07 Zr I		3.0	4377.98 Ta I		170	4383.55 Fe I	
3.5	4373.22 Ce II		11	4378.10 La II		4	4384.06 Tb II	
11 d	4373.23 V I		4	4378.18 Th I		10 c	4384.14 Pr II	
6	4373.25 Cr I		60	4378.24 Sm II		20	4384.29 Sm II	
3.5	4373.32 Mo I		5	4378.35 Er II		5	4384.30 Dy II	
8	4373.33 Ho I		22	4378.49 W I		2.0	4384.65 Th II	
8	4373.41 U II		18	4378.56 Gd I		24	4384.71 Er II	
30	4373.46 Sm II		11	4378.82 Ta I		550	4384.72 V I	
1.0 h	4373.63 Co I		19	4379.14 Ho II		7	4384.80 Pr	
2.5	4373.82 Ce II		950	4379.24 V I		12	4384.81 Sc II	
7	4373.82 Pr II		8	4379.33 Y I		20 c	4384.83 Ho II	
90	4373.83 Gd I		3.5	4379.34 Pr		7	4384.86 Nb I	
6	4373.83 V I		7	4379.52 Nb I		20	4384.86 W I	
6	4373.90 Th II		6 bl	4379.72 La LaO		44	4384.98 Cr I	
6	4374.13 Th I		22	4379.78 Zr II		10	4385.20 La II	
9	4374.16 Cr I		10	4379.83 Ho II		3.5 d	4385.31 Pr	
3.0	4374.21 Ta I		8	4379.92 Rh I			4385.48 Pr I	
26	4374.24 Dy II		8	4380.06 Ce II		80	4385.39 Ru I	
11	4374.41 Pr II		14	4380.29 Mo I		3.0	4385.48 Y I	
5	4374.43 Tb I		10	4380.32 Pr II		120	4385.65 Ru I	
180	4374.46 Sc II		36	4380.42 Sm I		42	4385.66 Nd II	
4	4374.78 Nb I		8	4380.55 V I		12	4385.68 Tb I	
9	4374.78 Th		3.5	4380.59 Mo I		2.5	4385.89 Mo I	
26	4374.80 Dy II		5	4380.64 Er I		16	4386.07 Ta I	
360	4374.80 Rh I		13	4380.64 Gd II		12	4386.08 Tb II	
4	4374.89 Mo I		4	4381.11 Cr I		4	4386.20 Gd I	
28 d	4374.93 Nd II		4	4381.13 Nb I		8	4386.22 Sm I	
	4375.04 Nd II		3.0	4381.27 Ru I		9	4386.27 Ru I	
1200	4374.94 Y II		8	4381.31 Tb I		5	4386.35 Ce II	
3.5	4374.95 Mn I		5	4381.41 Th I		24	4386.40 Er I	
22	4374.98 Sm II		180	4381.64 Mo I		100	4386.43 Tm I	
7	4375.01 Mo I		3.5	4381.70 Mn I		12	4386.70 Ce II	
5	4375.14 Ta I		8	4381.78 Ce II		50	4386.84 Ce II	
3.5	4375.17 Ce II		90	4381.86 Th II		3.0	4387.17 Gd I	
3.0	4375.25 Nb I		2.5	4381.88 Ta I		5	4387.50 Cr I	
8	4375.30 V I		9	4382.06 Gd II		17	4387.67 Gd II	
6	4375.33 Cr I		65	4382.17 Ce II		7	4387.74 Nb I	
10	4375.33 Dy II		13	4382.17 Er I		10	4387.74 Y I	
15 h	4375.61 Y I		7	4382.41 Mo I		6	4387.88 Eu I	
11 bl	4375.84 La LaO		14	4382.42 Pr II		22	4388.01 Ce II	
38	4375.92 Ce II		30	4382.46 Tb I		2.5	4388.08 Ti I	
6	4375.93 Fe I		2.5	4382.49 Nb I		28	4388.25 Tb I	
8	4376.07 Gd I		7	4382.74 Nd II		13	4388.36 Nb I	
3.0	4376.31 Ta I		5 c	4382.82 Pr II		5	4388.37 Er II	
5	4376.43 Tb II		3.5	4382.84 Nb I		8 c	4388.69 Ho II	
3.0	4376.45 Nd II		13	4383.12 Gd II		2.5	4388.99 Ru I	
9	4376.58 Ho II		5	4383.17 Eu II		1.4	4388.99 Sm II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
4 h	4389.60 Sc I		15	4394.42 Tm I		6	4399.88 Sm II	
6	4389.78 Dy I		5	4394.47 Mo I		8	4400.03 Pr II	
5 h	4389.81 Tb I		3	4394.50 Zr I		3.0	4400.18 Gd II	
6	4389.84 W I		3.0	4394.67 Y I		8	4400.24 Zr I	
6	4389.87 La I		2.5	4394.72 Gd II		7	4400.25 Pr II	
17	4389.88 Gd I		6	4394.78 Ce II		3.5	4400.35 Nb I	
380	4389.97 V I		46	4394.86 Os I		100	4400.37 Sc II	
17	4390.00 Gd		6	4394.90 Th II		5	4400.54 Ce II	
12	4390.28 Ce II		4	4394.92 Tb II		17	4400.55 Ho II	
160	4390.44 Ru I		12	4394.94 Zr I		5	4400.58 Os I	
15	4390.66 Nd II		3.0	4394.96 Ru I		110	4400.58 V I	
110	4390.86 Sm II		11	4394.98 Dy II		8	4400.76 Gd I	
24	4390.91 Tb I		8 h	4394.98 Ho I		6	4400.83 Nb I	
14	4390.95 Gd II		16	4395.01 Pr II		32	4400.83 Nd II	
8	4391.03 Ru I		28	4395.04 Ti II		5	4400.87 Ce II	
8	4391.08 Os I		9	4395.21 Zr I		28	4401.17 Sm I	
4	4391.10 Nd II		280	4395.23 V I		13	4401.24 Ho II	
80	4391.11 Th II		2.5	4395.50 Nd		4	4401.54 Tb II	
14	4391.34 Re I		16	4395.79 Pr II		12	4401.55 Ni I	
6	4391.44 Gd II		2.5	4395.89 Nd		4	4401.58 Th I	
4	4391.51 Pr		9	4395.96 Tm I		130	4401.86 Gd I	
7	4391.54 Mo I		24	4396.12 Pr II		3.5	4402.05 Nb I	
0.8	4391.57 Co I		5	4396.48 Th II		5 d	4402.30 U	
120	4391.66 Ce II		10	4396.49 Tm I			4402.44 U	
6	4391.75 Cr I		17	4396.56 Tb I		3.5	4402.49 Mo I	
1.8	4391.83 Pt I		5	4396.58 Ce II		19	4402.50 Ta I	
26	4392.06 Gd I		13	4396.66 Mo I		10	4402.54 Ba I	
7	4392.07 V I		6	4396.80 Re I		8	4402.60 Re I	
7	4392.12 Mo I		2.5	4396.87 Pr		5	4402.65 La I	
2.5	4392.12 Nd		7	4397.04 Nb I		14	4402.74 Os I	
7 cw	4392.45 Re I		14	4397.26 Os I		7	4402.90 Mo I	
2.0	4392.59 Ir I		14	4397.29 Mo I		4	4402.93 Th I	
1.4	4392.60 Sm II		20	4397.34 Sm I		6	4402.95 Zr I	
17	4392.69 Nb I		6	4397.42 Er I		55 d	4403.06 Sm II	
4	4392.96 Tb I		17	4397.51 Gd II			4403.13 Sm I	
4	4392.98 Th I		16	4397.80 Ru I		8	4403.14 Er II	
3.5	4393.09 V I		6	4397.92 Th II		48	4403.14 Gd I	
11	4393.19 Ce II		180	4398.02 Y II		7	4403.18 Tb I	
14	4393.35 Sm I		3.0	4398.03 Nd		20	4403.27 Ho I	
24	4393.60 U I		5	4398.27 Pr		6	4403.28 Pr II	
2.0	4393.76 Th I		12	4398.45 Ta I		4	4403.30 Ce II	
3.5 h	4393.76 Yb I		14	4398.79 Ce II		6	4403.34 Zr II	
3.5	4393.84 V I		3.5	4399.10 Th II		28	4403.36 Sm II	
14	4393.92 Ti I		36	4399.20 Ce II		5	4403.50 Cr I	
3.0	4394.01 Y I		16	4399.33 Pr II		15	4403.61 Pr II	
5	4394.03 Tb I		18	4399.47 Ir I		6	4403.67 V I	
9	4394.08 W I		2.5	4399.58 Nd		7	4403.78 Ir I	
2.5	4394.18 Nd II		3.5	4399.59 Ru I		11	4403.95 W I	
5	4394.32 Mo I		4	4399.73 Tm I		5	4404.21 Os I	
36 cw	4394.38 Re I		5	4399.77 Ti II		20	4404.28 Ti I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
3.0	4404.55 Mo I		5	4411.21 La II		22	4416.90 Ce II	
85	4404.75 Fe I		10	4411.52 Nb I		18	4417.28 Ti I	
3.0	4404.82 Ru I		240	4411.57 Mo I		11	4417.35 Hf II	
5	4404.90 Ti I			4411.70 Mo I		1.0	4417.40 Co I	
9	4405.15 Pr		20	4411.58 Sm I		26	4417.58 Sm II	
1.4 h	4405.27 Eu II		8	4411.83 Sm II		5	4417.72 Ti II	
7	4405.40 Tb II		4	4411.88 Mn I		14	4417.91 Hf I	
5	4405.47 Ce II		5	4411.93 Tb I		22 bl	4418.24 La LaO	
2.5	4405.67 Sm II		9	4412.02 Ce II		3.0	4418.25 Hf I	
2.5	4405.68 Ti I		11	4412.14 V I		5	4418.45 W I	
38	4405.85 Pr II		7 h	4412.16 Pr II		2.0	4418.66 Th II	
7 h	4406.15 V I		2.5	4412.18 Nb I		14	4418.71 Er I	
11 cw	4406.40 Re I		14	4412.20 W I		70	4418.78 Ce II	
3.5	4406.55 Nb I		3.0	4412.25 Cr I		32	4419.03 Gd II	
180	4406.64 V I		8	4412.27 Nd II		14	4419.06 Pr II	
24	4406.67 Gd II		6	4412.56 Th I		8	4419.16 La II	
6	4406.67 Pr		15	4412.74 Th II		5	4419.30 Ce II	
5	4406.76 Tb I		10	4412.77 Mo I		32	4419.33 Sm I	
3.5	4406.87 Mo I		17	4413.04 Zr I		20	4419.44 Nb I	
3.5	4407.07 Eu II		8	4413.19 Ce		5	4419.55 Ta I	
7	4407.08 Nd II		2.5	4413.44 Gd I		46	4419.62 Er II	
12	4407.28 Ce II		5	4413.63 Tb I		1.2	4419.66 Eu II	
4	4407.52 Sm II		6	4413.75 Er I		17	4419.67 Pr II	
220	4407.64 V I		36	4413.77 Pr II		4	4419.78 Mn I	
280	4408.20 V I		5	4413.80 Ce II		6	4419.83 Nb I	
24	4408.25 Gd II		4	4413.87 Cr I		9	4419.94 V I	
22	4408.28 W I		3.0	4414.14 Zr I		3.0 d	4420.11 Nd I	
360	4408.51 V I		80	4414.16 Gd I		13	4420.20 Tb I	
5 b	4408.81 Hf HfO		5	4414.34 Er I		6	4420.45 Nb I	
150	4408.84 Pr II		7	4414.40 Pr II		22	4420.46 Zr I	
7 d	4408.87 Ce II		4	4414.44 Nd II		440	4420.47 Os I	
6	4408.88 Th I		4	4414.52 Th I		10	4420.47 W I	
20	4409.25 Gd I		6	4414.54 Zr II		2.5	4420.52 Nd	
35	4409.33 Sm II		65	4414.73 Gd I		100	4420.53 Sm II	
65	4409.35 Er I		26	4414.88 Mn I		22	4420.56 Ho II	
44	4409.38 Dy II		3.0	4414.88 Nb I		10	4420.64 Nb I	
3.5	4409.44 Mo I		3.5	4415.06 V I		2.5	4420.66 Sc II	
9 d	4409.52 Tb II		5	4415.08 W I		6	4420.84 Ru I	
7	4409.95 Mo I		48	4415.12 Fe I		7 h	4420.96 Lu I	
150	4410.03 Ru I		10	4415.24 U II		65	4421.14 Sm II	
34	4410.21 Nb I		80	4415.56 Sc II		14 c	4421.23 Pr II	
2.0	4410.30 Cr I		14	4415.74 Ta I		13	4421.24 Gd II	
2.0	4410.47 Th II		18	4415.82 Re I		0.8	4421.34 Co I	
25	4410.64 Ce II		6	4416.23 Th II		15	4421.46 Ru I	
25	4410.76 Ce II		18	4416.27 Tb II		3.5	4421.54 Th II	
30	4411.06 Nd II		2.5	4416.41 Nb I		50	4421.57 V I	
5	4411.09 Cr I		50	4416.47 V I		10	4421.76 Ti I	
3.5	4411.13 Os I		5	4416.54 Ti I		3.5	4422.06 Mo I	
5	4411.14 Tb I		2.0	4416.84 Th I		3.5	4422.06 Th I	
48	4411.16 Gd I		8	4416.89 Nd II		3.0	4422.23 Hf I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
130	4422.41 Gd I		12	4427.58 Sm II		18	4432.96 Th II	
9	4422.47 Er II		4	4427.61 Gd II		4	4432.98 Ta I	
90	4422.59 Y II		4	4427.64 Th II		8	4433.08 Sm I	
10	4422.82 Ti I		8	4427.65 U II		2.0	4433.32 Rh I	
32	4423.11 Tb I		5	4427.81 Sm II		2.0	4433.58 Ti I	
16 bl	4423.17 La LaO		34	4427.92 Ce II		4	4433.64 Gd II	
7	4423.21 V I		10 bl	4428.10 La LaO		3.5	4433.73 Ce II	
5	4423.38 Sm I		22	4428.44 Ce II		110	4433.88 Sm II	
3.5	4423.44 Ce I		30	4428.46 Ru I		5	4433.89 U II	
20	4423.62 Mo I		2.0	4428.50 Cr I		14	4434.00 Ti I	
14	4423.68 Ce II		24	4428.52 V I		120	4434.32 Sm II	
9	4423.78 W I		5	4429.11 Zr I		9	4434.47 Tb II	
3.0	4423.87 Nb I		110 c	4429.24 Pr II		8	4434.53 U II	
16	4423.90 La I		46	4429.27 Ce II		7	4434.60 V I	
2.5	4423.91 V I		10	4429.44 Nb I		8	4434.81 Eu II	
4	4424.10 Gd II		32	4429.66 Sm I		2.0	4434.85 Pr	
2.0	4424.18 Pr		18	4429.80 V I		95	4434.95 Mo I	
5	4424.28 Cr I		9	4429.81 Ho II		65	4434.96 Ca I	
200	4424.34 Sm II		200	4429.90 La II		8	4434.96 Ho I	
2.0	4424.39 Ti I		5	4430.00 Ce		7	4435.01 Tb I	
3.5	4424.56 V I		1.8	4430.02 Ti I		7	4435.55 Tb II	
26	4424.57 Er I		4 d	4430.13 Tb II		900 cw	4435.56 Eu II	
14	4424.60 Pr II		3.5 h	4430.22 Yb I		18	4435.69 Ca I	
3.5	4424.78 Ru I		7	4430.37 Ti I		5	4435.85 La II	
3.5	4424.96 Ta I		7	4430.41 Ta I		1.6	4436.06 Th II	
11	4425.01 Gd I		20 c	4430.48 Lu I		22 d	4436.10 Gd I	
30	4425.44 Ca I		4	4430.49 Cr I			4436.22 Gd II	
7	4425.71 V I		2.5	4430.50 V I		22	4436.12 Tb I	
2.5	4425.83 Ti I		100	4430.63 Gd I		34	4436.14 V I	
5	4425.91 W I		9	4430.66 Tb I		2.0	4436.28 Th II	
36	4426.00 V I		5	4431.00 Dy II		26	4436.32 Os I	
2.5	4426.01 Sm II		3.5	4431.09 Ta I		16	4436.35 Mn I	
10	4426.06 Ti I		4	4431.28 Ti I		3.0	4436.55 Th II	
5	4426.15 Gd II		4	4431.36 Sc II		6	4436.59 Ti I	
6	4426.20 Ho II		14	4431.49 Zr I		10	4436.89 Mo I	
12	4426.27 Ir I		0.7	4431.62 Co I		18	4436.90 W I	
16	4426.67 Mo I		8	4431.76 Gd I		4.5	4437.09 Os I	
10	4426.68 Nb I		15	4431.89 Ba I		24 c	4437.22 Nb I	
5	4426.68 U II		2.0	4431.89 Pr I		1.2	4437.27 Au I	
30	4426.77 Er I		4	4432.18 Cr I		8	4437.34 Y I	
2.0	4426.83 Nd II		4	4432.21 Er I		4	4437.40 Tm II	
5	4426.87 Dy I		2.0	4432.25 Th I		8	4437.61 Ce II	
5	4426.94 U I		3.5	4432.30 Nd II		9	4437.67 Er I	
22	4427.07 Ce II		10	4432.34 Pr II		50	4437.84 V I	
75	4427.10 Ti I		9	4432.41 Os I		2.5	4437.90 Nb I	
11	4427.24 Zr I		2.5	4432.60 Ti I		10 bl	4438.01 La LaO	
6	4427.31 Fe I		10	4432.70 Tb I		18	4438.04 Hf I	
9	4427.31 V I		4	4432.72 Ce II		3.5 h	4438.04 Sr I	
4	4427.34 Tb I		5	4432.92 Ce II		8	4438.05 Zr I	
26	4427.55 La II		16 bl	4432.95 La LaO		8	4438.18 Pr II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
2.5	4438.23	Ti I	2.0	4444.27	Ti I	65	4449.87	Pr II
15	4438.27	Gd II	2.0	4444.29	Nd II	1.6	4450.18	Ir I
5	4438.30	W I	2.5	4444.33	Zr I	7 c	4450.21	Pr II
3.5	4438.79	Lu I	34	4444.39	Ce II	8	4450.28	Zr I
6	4438.96	Mo I	8	4444.51	Ru I	5	4450.36	W I
9	4438.97	Tb II	12	4444.61	Dy I	2.5	4450.49	Ti II
5	4439.00	Nd II	14	4444.63	Ho I	8	4450.72	Ta I
10	4439.12	Th II	32	4444.70	Ce II	44	4450.73	Ce II
26	4439.21	Yb I	3.0	4444.98	Gd I	20	4450.81	Lu I
6	4439.24	Ce II	3.5	4444.99	Nd I	46	4450.90	Ti I
10	4439.38	Tb I	2.0	4445.01	Th I	5	4450.90	V I
9	4439.64	Os I	8	4445.07	Ho II	80	4451.57	Nd II
42	4439.76	Ru I	48	4445.15	Sm I	60	4451.59	Mn I
11	4440.35	Ti I	10	4445.15	W I	8	4451.64	Tb I
2.0	4440.43	Nb I	1.4	4445.55	Pt I	2.0 h	4451.87	Ta I
6	4440.44	Re I	3.5	4445.69	Os I	12	4451.95	Pr II
7	4440.46	Zr II	0.8	4445.72	Co I	12	4451.99	Nd II
3.0	4440.58	Th	6	4445.85	Nb I	48	4452.01	V I
3.0	4440.74	U I	6	4445.87	Pr II	10	4452.15	La I
10	4440.86	Th II	2.5	4445.88	Sm	4	4452.55	Ce
9	4440.88	Ce II	2.0	4445.89	Th II	3.0	4452.56	Mo I
6	4441.03	Ta I	4	4446.15	Ce	1.8	4452.56	Th I
4	4441.27	Tb II	8	4446.17	Nb I	2.0	4452.70	V I
4	4441.27	Ti I	34	4446.39	Nd II	3.5	4452.73	Gd I
7 h	4441.48	Tb I	8	4446.43	Mo I	90	4452.73	Sm II
8	4441.68	Ta I	7	4446.49	Gd II	8 d	4452.82	Tb I
65	4441.68	V I	13	4446.63	Y I	17	4452.95	Sm I
6	4441.81	Nb I	3.0	4446.96	Sm II	5	4453.00	Hf I
36	4441.81	Sm I	8	4446.99	Pr II	12	4453.00	Mn I
8	4441.81	W I	30	4447.18	Nb I	4	4453.16	Ce II
19	4442.20	Mo I	9	4447.23	Ho II	70	4453.32	Ti I
30	4442.28	Sm I	2.0	4447.23	Mo I	24	4453.71	Ti I
5	4442.34	Fe I	20	4447.35	Os I	3.0 c	4453.92	Re I
7	4442.51	Sm II	3.5	4447.59	Tm I	3.5	4453.93	Gd II
8	4442.55	Pt I	2.0	4447.69	Ce I	9	4454.04	Tm I
6	4442.74	Tm I	5	4447.72	Fe I	6	4454.38	Pr II
5 bl	4443.00	La LaO	8	4447.83	Th II	1.8	4454.51	Th II
13	4443.00	Zr II	22	4448.04	Tb I	3.0	4454.62	Re I
5 h	4443.07	Hf I	4	4448.62	Er II	80	4454.63	Sm II
10	4443.07	Mo I	2.5	4448.95	Zr I	12	4454.70	Pr
3.5	4443.07	Th	10	4449.01	W I	140	4454.78	Ca I
2.0	4443.20	Fe I	2.5	4449.02	Gd I	6	4454.99	Ce II
3.5	4443.27	Sm I	70	4449.15	Ti I	10	4455.01	Mn I
7	4443.34	V I	55	4449.34	Ce II	2.0	4455.30	Mo I
10	4443.66	Y I	40	4449.34	Ru I	12	4455.32	Mn I
11	4443.75	Ce II	2.5	4449.41	Gd I	80	4455.33	Ti I
19	4443.80	Ti II	5	4449.57	V I	5	4455.43	Zr I
5 c	4444.01	Pr	7	4449.64	Ce	4	4455.46	W I
50	4444.21	V I	60	4449.71	Dy II	9	4455.59	Dy II
48	4444.26	Sm II	32	4449.74	Mo I	6	4455.66	Ce

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
10	4455.80 La II		6	4460.99 V I		9	4465.98 Pr II	
8	4455.82 Mn I		11	4461.08 Mn I		15	4466.35 W I	
18	4455.89 Ca I		6 d	4461.08 Th II		4	4466.40 Hf II	
6	4456.11 Sm II			4461.24 Th I		2.5	4466.42 Nb I	
4	4456.11 W I		32	4461.14 Ce II		6	4466.55 Fe I	
5	4456.30 Zr I		12	4461.18 Hf I		28	4466.55 Gd II	
18	4456.40 Nd II		8	4461.22 Zr II			4466.60 Gd I	
3.0 h	4456.50 V I		4	4461.27 Tb I		15	4466.73 W I	
1.0	4456.62 Ca I		6 h	4461.29 Pr		2.5	4466.89 Co I	
15	4456.80 Nb I		3.0	4461.36 Gd I		10	4466.91 Zr I	
4	4457.04 Mn I		3.0	4461.51 Th I		48	4467.08 Gd I	
12	4457.34 Hf I		3.0	4461.65 Fe I		7	4467.23 Gd II	
46	4457.36 Mo I		3.0	4461.72 Th II		2.0	4467.26 Ru I	
15	4457.42 Nb I		38	4462.02 Mn I		8	4467.28 Ho I	
90	4457.43 Ti I		1.8	4462.09 Ti I		150	4467.34 Sm II	
10	4457.43 Zr I, II		3.0	4462.29 Os I		20	4467.54 Ce II	
32	4457.48 V I		48	4462.36 V I		3.0	4467.54 Re I	
16	4457.55 Mn I		10	4462.42 Nd II		10	4467.70 Tb I	
9	4457.76 V I		2.0	4462.46 Ni I		5	4467.85 Nd II	
3.0	4457.78 Ce II		10	4462.83 Gd I		8	4467.92 Re I	
6	4458.00 Th I		11	4462.97 U II		3.5	4467.98 Tm II	
5	4458.09 W I		44	4462.99 Nd II		9	4468.01 V I	
6	4458.12 Nb I		5	4463.25 Gd II		20	4468.17 Dy II	
20	4458.26 Mn I		6	4463.38 Ti I		2.5	4468.22 Zr I	
4	4458.30 W I		7	4463.40 Ho II		18	4468.28 Mo I	
2.0 d	4458.32 Gd I		30	4463.41 Ce II		20	4468.50 Ti II	
	4458.41 Gd I		8	4463.50 W I		85	4468.71 Pr II	
8 h	4458.34 Pr II		3.0	4463.53 Re I		3.0	4468.76 V I	
70	4458.52 Sm II		8	4463.54 Ti I		4	4468.79 Zr I	
9	4458.54 Cr I		2.0	4463.90 Sm I		4	4468.97 La I	
3	4458.65 Mo I		9	4464.15 Nb I		6	4469.12 Tb I	
9	4459.04 Ni I		4	4464.17 Ce II		8	4469.26 Nd II	
5	4459.12 Fe I		3.0	4464.27 V I		5	4469.32 Nb I	
8	4459.26 Er II		22	4464.68 Mn I		4	4469.32 U I	
17	4459.29 Sm I		10	4464.69 Ce II		4	4469.53 Th I	
4 h	4459.38 Tb II		28	4464.74 Gd I		4	4469.56 Co I	
7 d	4459.53 Os I		3.0	4464.75 V I		2.0	4469.66 Pr	
2.5	4459.74 Cr I		6	4464.77 Mo I		6	4469.66 Sm II	
10	4459.76 Ta I		5	4464.97 Eu II		14	4469.71 Nb I	
80	4459.76 V I		6	4465.07 Nd II		30	4469.71 V I	
6	4459.98 Tm I		5	4465.13 U II		15	4470.14 Mn I	
100	4460.04 Ru I		2.0	4465.27 Y I		8	4470.23 Ho I	
5	4460.20 Nb I		16	4465.34 Th II		10	4470.31 Zr I	
170	4460.21 Ce II		2.5	4465.36 Cr I		6	4470.48 Ni I	
160	4460.29 V I		3.0	4465.44 Ce		17	4470.56 Zr I	
2.5	4460.34 Zr I		3.0	4465.50 V I		55	4470.89 Sm I	
4	4460.38 Mn I		7	4465.60 Nd II		5	4470.97 Nd II	
9	4460.42 Nb I		24	4465.81 Ti I		100	4471.24 Ce II	
15	4460.50 W I		2.5	4465.92 Nb I		20	4471.24 Ti I	
6	4460.62 Mo I		3.0	4465.94 Os I		10	4471.29 Gd II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
14	4471.29	Nb I	5	4477.71	U II	4.0	4485.54	Pr
5	4471.41	Nd II	8	4477.88	Nd I	2.0	4485.57	Sm II
1.6	4471.55	Co I	8	4477.99	Re I	3.5	4485.68	Tb I
5 h	4471.55	Lu I	0.9	4478.32	Co I	3.0	4485.78	Th II
5	4471.66	Mo I	12	4478.39	Re I	2.5	4485.95	Nd II
4	4471.72	Tb II	6	4478.48	Ir I	4	4486.06	La I
5	4472.04	Mo I	50	4478.66	Sm II	5	4486.13	Hf II
2.5	4472.25	Th	20	4478.80	Gd II	6	4486.35	Gd II
44	4472.34	U II	50	4479.36	Ce II	1.8	4486.65	Th II
32	4472.43	Sm II	3.0	4479.40	Mn I	26	4486.90	Gd I
14	4472.53	Nb I	2.5	4479.41	Ru I	1.8	4486.90	Th I
32	4472.72	Ce II	8	4479.70	Ti I	60	4486.91	Ce II
10	4472.79	Mn I	8	4479.81	Os I	8	4487.05	Mo I
5	4472.93	Pr	6	4480.04	V I	11	4487.28	Y I
42	4473.02	Sm II	8	4480.32	Sm I	30	4487.47	Y I
12	4473.18	Mo I	14	4480.45	Ru I	8	4487.50	Th II
6	4473.28	Gd I	4	4480.59	Ti I	2.5	4487.82	Pr II
8	4473.50	Er II	3	4480.77	Zr I	3.5	4488.05	Cr I
10	4473.52	Ta I	6	4480.82	Th II	8	4488.16	Tb I
11	4473.59	Ho II	5	4480.93	Ta I	6	4488.17	Pr II
20	4473.59	Pd I	8	4480.97	Nd I	2.5	4488.25	Au I
5	4473.84	Pr II	26	4481.06	Gd II	1.6	4488.32	Ti II
4	4473.89	Y I	44	4481.26	Ti I	8	4488.39	Ru I
17	4473.93	Ru I	40	4481.27	Tm II	6 h	4488.40	Gd II
9	4474.04	V I	5	4481.28	W I	3.5	4488.60	Os I
5	4474.04	W I	3.0	4481.44	Nb I	10	4488.68	Th II
3.0	4474.07	Th II	4	4481.90	Nd I	3.0	4488.81	Ce II
65	4474.13	Gd I	3.0	4482.03	Ru I	2.5	4488.89	Er
60	4474.56	Mo I	3.0	4482.13	Th I	30	4488.89	V I
	4474.65	Mo I	3.0 d	4482.17	Fe I	3.0	4488.97	Ba I
3.0	4474.69	Ce II		4482.26	Fe I	3.0	4489.00	Mo I
16	4474.71	V I	5 h	4482.44	Yb I	5	4489.02	W I
8	4474.85	Ti I	4	4482.50	Zr I	4	4489.08	Er
15	4475.08	Re I	8	4482.69	Ti I	22	4489.09	Ti I
5	4475.18	Sm II	2.5	4482.88	Cr I	4	4489.47	Cr I
3.0	4475.28	Nb I	20	4483.33	Gd II	6	4489.71	Tm II
2.5	4475.57	Nd II	3.0	4483.49	Pr	1.8	4490.02	Sm I
9	4475.62	Mo I	50	4483.90	Ce II	13	4490.08	Mn I
17	4475.72	Y I	0.8	4483.93	Co I	6	4490.19	Mo I
1.8	4475.84	Nd I	70	4484.19	W I	5	4490.24	Ru I
2.0	4475.89	V I	5	4484.37	Dy I	6	4490.80	V I
6	4476.02	Fe I	7	4484.47	Er	8	4490.84	U II
5 hl	4476.08	Ag I	13	4484.57	Ho II	6	4491.01	Tb I
80	4476.12	Gd I	20	4484.70	Gd I	22	4491.28	Mo I
18	4476.96	Y I	11	4484.76	Os I	2.5	4491.56	Zr I
12 c	4477.26	Pr II	12	4484.82	Ce	3.0	4491.66	Mo I
16	4477.45	Y I	14	4484.97	Mo I	4	4491.68	Ru I
3.0	4477.46	Nd II	1.6	4485.15	Eu II	3.0	4491.75	Y I
3.5	4477.50	Sm I	2.5	4485.48	Gd I	3.0	4492.24	Th II
34	4477.64	Ho II	6	4485.52	Ce II	5	4492.31	Cr I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
5	4492.33 W I		18	4497.85 Ce II		1.8	4506.36 Ti I	
2.5	4492.42 Y I		1.7	4497.92 Th I		7	4506.42 Ce I	
5 c	4492.43 Pr II		5	4497.93 Nd II		1.7	4506.49 Th I	
3.0	4492.47 Rh I		32	4498.14 Ru I		12	4506.59 Nd II	
2.0	4492.55 Ti I		16	4498.28 Gd II		5	4506.67 Mo I	
3.0 d	4492.93 Pr I		3.5	4498.47 W I		2.0	4506.85 Cr I	
	4493.12 Pr II		4	4498.73 Cr I		5	4506.93 Gd II	
3.0	4492.95 Ce II		2.5	4498.76 Pt I		12 c	4507.04 Re I	
2.0	4492.96 Nb II		6 h	4498.85 Lu I		50	4507.12 Zr I	
40	4493.08 Tb I		18	4498.90 Mn I		5	4508.01 Re I	
4	4493.11 La I		8	4498.96 Th I		5	4508.08 Ce II	
12	4493.33 Th I		25	4499.11 Sm I		5	4508.41 Nb I	
5	4493.42 Nd II		5	4499.44 Mo I		4 d	4509.04 Tb II	
3.5 h	4493.64 Ba I		4	4499.47 Tb I		5	4509.08 Gd II	
3.0	4493.71 Pr		25	4499.48 Sm II		6 d	4509.14 Ce II	
8	4493.97 W I		5	4499.65 Hf I			4509.26 Ce II	
3.0	4494.19 Pr II		8	4499.80 Nb I		11	4510.10 Ru I	
10	4494.22 Ce II		5	4499.99 Th I		70	4510.16 Pr II	
5	4494.42 Zr II		9	4500.22 La I		4	4510.17 Ce II	
9	4494.51 W I		6	4500.30 Cr I		5	4510.32 U II	
6	4494.57 Fe I		6	4500.34 Ce II		20	4510.53 Th II	
5	4494.57 Nb I		16	4500.75 Er II		16	4510.82 Ho I	
4	4494.71 La I		1.8	4501.10 Ce I		3.5	4510.92 Ce II	
0.7	4494.76 Co I		4	4501.11 Cr I		38 c	4510.98 Ta I	
2.5	4494.94 Zr I		17	4501.27 Ti II		8	4511.09 Nb I	
4	4494.97 Ta I		5	4501.29 Mo I		4	4511.17 Ti I	
3.5	4495.01 Ti I		4	4501.38 Sm II		8	4511.20 Ru I	
1.6	4495.14 Sm II		1.8	4501.79 Cr I		1800 c	4511.31 In I	
5	4495.30 W I		24	4501.82 Nd II		8	4511.33 Sm I	
1.8	4495.35 Ir I		3.5	4501.83 Pr II		8	4511.50 Ta I	
9	4495.39 Ce II		9	4501.95 V I		14 h	4511.52 Tb I	
1.2 h	4496.03 Ir I		18	4502.22 Mn I		6	4511.64 Ce II	
8	4496.06 V I		16	4503.04 Nb I		38	4511.83 Sm II	
20	4496.15 Ti I		5	4503.26 Dy II		8	4511.90 Cr I	
10	4496.23 Ce II		3.5	4503.27 Er II		2.0	4512.13 Nb I	
3.0	4496.32 Th II		16	4503.38 Sm I		13	4512.15 Mo I	
10	4496.38 Er		2.5	4503.42 Nb I		3.0	4512.18 Er I	
95	4496.43 Pr II		2.5	4503.78 Rh I		3.0	4512.50 Th II	
2.5	4496.43 Re I		3.5	4503.78 Ti I		10	4512.55 Ho II	
4	4496.50 Ta I		2.5	4503.79 Gd I		65	4512.74 Ti I	
5	4496.85 V I		4	4504.17 W I		14	4512.91 W I	
55	4496.86 Cr I		5 c	4504.59 Pr		4	4512.96 Tb II	
18	4496.97 Zr II		18	4504.86 W I		13	4513.30 W I	
46	4497.13 Gd I		11	4504.90 Mo I		260	4513.31 Re I	
2.0	4497.25 Nb I		12	4505.05 Sm II		10	4513.34 Nd II	
2.5	4497.27 Nd II		4	4505.22 Th I		5	4513.58 Y I	
20	4497.32 Gd I		13	4505.92 Ba I		4	4513.69 Th I	
2.5	4497.40 Nd I		50	4505.95 Y I		8	4514.01 Y I	
3.0	4497.40 V I		40	4506.21 Gd I		6	4514.19 V I	
2.0	4497.73 Ti I		13	4506.33 Gd II		7	4514.31 Tb II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
1.0	4514.37	Cr I	6	4521.09	Ta I	90	4527.25	Y I
13	4514.50	Gd II	2.0	4521.14	Cr I	65	4527.31	Ti I
3.0	4514.53	Cr I	5 h	4521.22	Th I	6 d	4527.34	Cr I
30	4515.09	Sm II	5	4521.30	Gd II		4527.47	Cr I
3.0	4515.12	Th I	3.5	4521.71	Ta I	60	4527.35	Ce II
5	4515.17	Yb II	7	4521.94	Gd II	4	4527.42	Sm I
8	4515.18	Mo I	3	4521.96	Ce I	7	4527.50	Ta I
18	4515.28	U II	4 h	4522.05	Y I	8 d	4527.63	Dy
1.6	4515.62	Ti I	1.6	4522.08	Ce II		4527.76	Dy II
8	4515.86	Ce II	5	4522.19	Mo I	2.5	4527.65	Nb II
3.0	4515.98	Th II	85	4522.37	La II	44	4527.80	Y I
15	4516.36	Nd II	4	4522.55	Sm I	3.0	4527.99	V I
2.0	4516.46	Pr	200	4522.57	Eu II	60	4528.47	Ce II
26	4516.64	Re I	19	4522.57	Tm II	10	4528.62	Fe I
5	4516.73	U I	10	4522.72	Er I	3 h	4528.62	Mo I
20	4516.89	Ru I	50	4522.73	Re I	2.0	4528.72	Rh I
5	4516.94	Dy I	1.6	4522.78	Th II	7	4528.97	Re I
8	4516.98	Gd I	85	4522.80	Ti I	3.0	4529.30	V I
1.6	4517.04	Th II	28	4522.82	Gd II	13	4529.38	Tm II
1.6	4517.11	Co I	4	4522.84	Nd II	11	4529.40	Mo I
22	4517.13	Mo I	30	4523.04	Sm II	2.5	4529.42	Nb I
2.0	4517.27	Sm II		4523.18	Sm I	1.4	4529.50	Th II
5	4517.41	Mo I	55	4523.08	Ce II	6	4529.59	V I
18 c	4517.60	Pr II	2.5	4523.13	Zr I	6	4529.67	Os I
20	4517.82	Ru I	5 h	4523.24	Ba I	4	4529.76	Tb
2.5	4518.02	Ce I	55	4523.41	Nb I	4	4529.76	W I
85	4518.03	Ti I	2.5	4523.58	Nd II	2.0	4529.85	Cr I
4	4518.29	Hf I	12	4523.88	Re I	4	4529.94	Nd I
2.0	4518.44	Mo I	44	4523.91	Sm II	12	4529.95	Re I
5	4518.53	Dy II	14	4524.12	Gd I	19	4530.08	Ho II
340	4518.57	Lu I	8	4524.12	Nb I	1.6	4530.32	Th I
3.0	4518.64	Er I	11	4524.22	V I	4	4530.47	W I
1.6	4518.64	Th II	22	4524.34	Mo I	32	4530.74	Cr I
8	4518.70	Ti I	40	4524.74	Sn I	2.0	4530.78	Cu I
3.0	4518.89	Os I	3.0	4524.85	Th II	3.0	4530.79	V I
4	4519.17	W I	6	4524.87	Os I	6	4530.85	Ru I
1.6	4519.26	Th I	13	4524.93	Ba II	20	4530.85	Ta I
6	4519.46	Er II	4	4525.01	Tb II	5	4530.89	Re I
7	4519.59	Ce II	2.0	4525.10	Th II	10	4530.96	Co I
11	4519.61	Tm I	3.0	4525.16	V I	5	4531.09	Pr II
60	4519.63	Sm II	17	4525.31	La II	3.0	4531.11	Er II
100	4519.66	Gd I	8	4526.01	Re I	2.0	4531.15	Fe I
4	4519.72	Tb II	2.0	4526.11	Cr I	19 c	4531.28	Ho I
1.6	4519.75	Th I	42	4526.12	La II	6	4531.31	Ce I
8	4519.76	Re I	11 c	4526.14	Ho II	15 c	4531.65	Ho
6	4520.07	Gd II	8	4526.37	Mo I	5	4531.71	Th II
3.0	4520.32	Os I	32	4526.47	Cr I	4 h	4531.83	Tb II
5	4520.78	Pr II	3.0	4526.92	Er II	3.0	4532.01	Ce I
1.2	4520.90	Pt I	1.6 h	4526.94	Ca I	6	4532.15	Tm I
10	4520.95	Ru I	7	4527.25	Nd I	6	4532.26	Th II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
5	4532.44	Sm I	20	4540.02	Gd II	2.5	4545.87	Ce II
8	4532.49	Ce	20	4540.19	Sm II	50	4545.96	Cr I
500	4533.24	Ti I	4	4540.41	Th II	3.0	4546.06	Ce I
12	4533.29	Th II	20	4540.50	Cr I	17	4546.49	W I
20	4533.80	Sm I	20	4540.72	Cr I	50	4546.82	Nb I
3.0	4533.92	V I	12	4540.93	Hf I	3.0	4547.15	Ta I
20	4533.97	Ti II	3.0	4541.07	Cr I	16	4547.33	Ru I
3.0	4533.99	Co I	20	4541.27	Nd II	2.5	4547.85	Nb I
5	4534.12	Th II	1.6	4541.51	Cr I	10	4547.85	Ru I
4	4534.13	Tb I	4	4541.56	Mo I	22	4548.00	Gd I
30 c	4534.15	Pr II	8	4541.70	Dy II	5	4548.24	Nd I
2.0	4534.22	Ce	3.0	4541.79	La I	3.5	4548.48	Ir I
19	4534.58	Ho I	4	4541.80	Re I	7	4548.54	Pr II
7	4534.71	W I	28	4542.03	Gd I	8	4548.60	Tm I
300	4534.78	Ti I	5	4542.06	Nd I	10	4548.66	Os I
9	4535.05	W I	26	4542.06	Sm II	3.0	4548.73	Rh I
4	4535.15	Cr I	44	4542.22	Zr I	80	4548.77	Ti I
3.0	4535.25	Th I	6	4542.54	Pr II	4	4548.88	Ce I
4	4535.38	Mo I	6	4542.55	Sc I	10	4548.94	Ho II
200	4535.58	Ti I	20	4542.61	Nd II	2.5	4549.02	Nd II
3 h	4535.59	Eu I	2.0	4542.62	Cr I	10	4549.07	Tb I
20	4535.72	Cr I	4	4542.80	Nb I	2.5	4549.43	Ru I
55	4535.75	Zr I	4	4542.89	W I	8	4549.50	La I
30	4535.92	Pr II	17	4543.51	W I	20	4549.63	Ti II
100	4535.92	Ti I	46	4543.63	U II	5	4549.64	Ce II
100	4536.05	Ti I	2.5	4543.69	Ru I	8	4549.65	V I
18	4536.51	Sm II	7	4543.80	Ho I	4	4549.66	Co I
7	4536.66	W I	2.5	4543.81	Co I	4	4549.72	Tb II
38	4536.80	Mo I	55	4543.95	Sm II	3.5	4549.84	Pr
6	4536.89	Ce II	2.5	4543.97	Pr	4	4549.96	Ru I
9	4536.97	Gd I	7	4544.02	Hf I	3.0	4550.03	Sm I
5	4537.08	Th II	6	4544.23	Gd I	2.5	4550.06	Pr II
8 d	4537.14	Tb I	2.5	4544.26	Nd II	5	4550.30	Ce II
	4537.23	Tb I	1.4	4544.27	Rh I	48	4550.41	Os I
2.0	4537.23	Ti I	10	4544.32	Y I	10	4550.45	Tb I
2.5	4537.62	Os I	5	4544.52	Th II	1.4	4550.78	Ir I
3.0	4537.66	V I	12	4544.62	Cr I	3.0	4550.88	Pr II
85	4537.81	Gd I	8	4544.68	Sc I	6	4550.95	Gd II
5	4537.88	Ce II	60	4544.69	Ti I	18	4551.30	Ce II
48	4537.95	Sm II	7	4544.83	Sm II	12	4551.30	Os I
14	4538.19	U II	15	4544.96	Ce II	1.6	4551.49	Th I
10	4538.53	Sm II	10	4545.17	Re I	3.5	4551.64	Rh I
8	4539.07	Ce II	2.0	4545.33	Nd II	2.0	4551.84	V I
2.0	4539.10	Ti I	2	4545.34	Cr I	16	4551.85	W I
5 h	4539.29	Pr	28	4545.39	V I	14	4551.95	Ta I
60	4539.75	Ce II	11	4545.58	U II	3.5	4551.98	U I
3.5	4539.79	Cr I	6	4545.68	Ir I	1.6	4552.07	Ce I
6	4539.92	Os I	2.0	4545.81	Sm II	4	4552.11	Ru I
7	4539.98	Zr I	2.5	4545.84	Th II	10 d	4552.13	Er II
3.0	4540.01	V I		4545.92	Th I	2.5	4552.16	Th I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
6	4552.26 Pr I		5	4558.60 Ce II		1.6	4564.17 Cr I	
3.5	4552.42 Pt I		1.8	4558.66 Cr II		1.6	4564.19 Th II	
80	4552.46 Ti I		2.5	4558.74 Mo I		3.0	4564.39 Y I	
28	4552.66 Sm II		4	4558.97 W I		38	4564.53 Nb I	
18	4553.01 Zr I		4	4559.11 W I		2.5	4564.59 Gd I	
7	4553.05 V I		5	4559.27 Re I		3.5	4564.69 Ru I	
1.6	4553.06 Ce I		11	4559.29 La II		6	4564.69 Tm I	
5	4553.32 Mo I		10	4559.37 Y I		3.0	4564.85 Tb II	
2.0	4553.59 Yb II		2.0	4559.42 Nb I		11	4565.11 Dy I	
5	4553.69 Ta I		5	4559.46 Ta I		1.4	4565.19 Rh I	
2.5	4553.80 Mo I		2.5	4559.62 Gd I		4	4565.24 Ce I	
9	4553.84 Nb I		10	4559.67 Nd I		5 c	4565.30 Re I	
3.0	4553.86 U II		7	4559.68 Re I		4	4565.32 W I	
4	4553.97 Zr II		5	4559.92 Ti I		4	4565.47 Zr I	
6500	4554.03 Ba II		10	4559.98 Ru I		10	4565.51 Cr I	
18	4554.45 Sm II		8	4560.13 Mo I		6	4565.59 Co I	
500	4554.51 Ru I		46	4560.28 Ce II		30	4565.84 Ce II	
2.0	4554.56 Ce II		3.5	4560.42 Nd I		18	4565.85 Ta I	
2.0	4554.97 Nd II		16	4560.43 Sm II		22	4565.94 Hf I	
4	4554.99 Gd II		22	4560.71 V I		32	4566.21 Sm II	
2.0	4555.08 Ti I		1.6	4560.89 Rh I		4	4566.38 Er II	
6	4555.10 U II		2.5 b	4560.95 Lu LuO		2.5	4566.66 Th II	
18	4555.13 Zr I		22	4560.96 Ce II		4	4566.77 Sm I	
3	4555.14 Nd II		4 d	4561.08 Gd I		3.0	4566.86 Ta I	
5	4555.24 Dy I		3.5	4561.18 Nd II		5	4567.07 Dy I	
40	4555.36 Cs I		1.2	4561.19 Sm II		3.0	4567.11 Tm II	
5	4555.43 Ce		5	4561.36 Th I		1.6	4567.25 Th I	
60	4555.49 Ti I		1.8	4561.48 Ta I		5	4567.61 Nd II	
13	4555.52 Zr I		4	4561.86 Nd I		8	4567.68 Mo I	
4	4555.71 Er I		3.0	4561.86 Tm II		7	4567.69 U II	
5	4555.81 Th I		2.0	4562.12 Zr I		7 c	4567.82 Ho II	
6	4556.14 Nd II		5	4562.24 Tb II		16	4567.91 La I	
4	4556.17 Cr I		150	4562.36 Ce II		4	4568.09 Ir I	
1.8	4556.22 Ce		22	4562.52 Ho I		2.0 h	4568.55 Pr II	
9	4556.35 Ta I		2.0	4562.60 Ru I		11	4569.00 Rh I	
10	4556.46 Tb I		4	4562.63 Ti I		2.0	4569.02 Mo I	
6 d	4556.54 Sm II		18	4563.13 Pr II		3.0	4569.31 Er I	
	4556.63 Sm I		20	4563.22 Nd II		2.5	4569.58 Sm I	
3.0	4556.69 Tm II		13	4563.28 Er II		8	4569.64 Cr I	
5	4556.74 Nd II		7	4563.28 Th II		3	4569.66 Ce	
4	4556.84 Nb I		2.0	4563.38 Ce II		10	4569.91 U II	
4	4556.87 W I		3.0	4563.43 Ti I		0.7 h	4570.02 Co I	
11 h	4557.24 Sc I		8	4563.59 W I		2.0	4570.02 Ir I	
1.6	4557.86 Ti I		3.0	4563.66 Th I		20	4570.02 La I	
4	4558.04 Zr I		10	4563.69 Tb II		5	4570.13 Mo I	
11	4558.08 Gd II		9	4563.77 Ti II		5	4570.42 V I	
10	4558.11 Mo I		3.0	4563.92 Er I		6 h	4570.57 Pr II	
1.6	4558.11 Ti I		4	4563.96 U		15	4570.66 W I	
5	4558.41 Ho II		5 h	4564.00 Yb I		3.0	4570.91 Ti I	
40	4558.46 La II		4	4564.10 Sm II		2.5	4570.95 Nb I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
5	4570.97	Th I	5 h	4578.14	Pr II	8	4584.26	Gd I
3.0 h	4570.98	Gd II	4	4578.34	W I	2.5	4584.37	Th II
3.0	4570.99	U II	2.5	4578.56	Ca I	160	4584.44	Ru I
1.2	4571.31	Rh	19	4578.69	Tb II	38	4584.83	Sm II
2.5	4571.61	Pr	3.0	4578.72	Sm II	6	4584.84	Tb II
10	4571.68	Cr I	11	4578.73	V I	4	4584.85	U II
16	4571.78	V I	5	4578.78	Ce	8	4585.87	Ca I
20	4571.98	Ti II	12	4578.89	Nd II	2.5	4586.06	Mo I
2.0	4572.13	Pr I	3.0	4579.04	Os I	2.0	4586.14	Cr I
8	4572.20	Gd I	5	4579.09	Sm II	65	4586.36	V I
75	4572.28	Ce II	2.5	4579.19	V I	2.5	4586.57	Mo I
6	4572.42	Ho II	6	4579.28	Ce	6	4586.62	Nd I
12	4572.67	Be I	12	4579.32	Nd II	2.0	4586.79	Mo I
6	4572.79	Ce II	2.5	4579.45	Nb II	7	4586.85	W I
75	4573.08	Nb I	26	4579.59	Gd I	3.5	4586.96	Nd I
5	4573.19	Tb II	14	4579.64	Ba I	15	4586.99	Gd I
5	4573.29	Ta I	4	4579.70	W I	4	4587.10	Ru I
6 h	4573.56	Y I	30	4580.06	Cr I	6	4587.93	Dy II
12	4573.69	U II	20	4580.06	La II	2.5	4588.22	Th II
2.0	4573.71	Th I	6	4580.07	Ru I	4	4588.43	Th I
2.0	4573.79	Hf II	0.7	4580.14	Co I	19	4588.75	W I
12	4573.81	Gd I	50	4580.40	V I	3.0	4589.12	Th II
8	4573.85	Ba I	12	4580.68	Re I	4	4589.22	Yb I
5	4573.85	Dy II	3.0	4580.69	Ta I	170	4589.37	Dy I
14 h	4573.99	Sc I	2.5	4581.09	Ce I	3.0	4589.43	Sm II
36	4574.31	Ta I	8	4581.09	Gd II	2.5	4589.66	Th I
2.0	4574.33	Nb I	1.6	4581.20	Th I	8	4589.70	Ho
4	4574.48	Mo I	38	4581.29	Gd I	2.0	4589.95	Ti II
	4574.61	Mo I	3.5	4581.32	Y I	1.8	4590.16	Zr I
1.8	4574.50	Zr II	5	4581.40	Ca I	2.5 h	4590.38	Mo I
8	4574.84	Nb I	20	4581.58	Sm I	13	4590.55	Zr I
40	4574.88	La II	3.0	4581.58	Th II	8	4590.84	Yb I
1.8	4575.12	Cr I	8	4581.60	Co I	10	4591.10	Ru I
1.6	4575.27	Th II	50	4581.62	Nb I	9	4591.12	Ce II
2.5 b	4575.31	Lu LuO	30	4581.73	Sm I	13	4591.22	V I
4	4575.37	Nb I	3.0	4581.77	Y I	30	4591.39	Cr I
1.6	4575.43	Th II	8	4582.29	Nb I	6	4591.56	Tb II
44	4575.52	Zr I	9	4582.29	Zr I	2.5	4591.68	Re I
24	4575.91	Gd I	2.5	4582.35	Mo I	5	4591.78	Dy II
3.5	4576.20	Zr I	12	4582.36	Yb I	20	4591.82	Sm II
38	4576.21	Yb I	9	4582.38	Gd II	2.0	4592.15	Pr
6 h	4576.32	Pr II	30	4582.50	Ce II	4	4592.21	Mo I
4	4576.48	Ce II	2.5	4582.50	Mo I	4	4592.38	Tb I
20	4576.50	Mo I	12	4582.53	Gd II	8	4592.42	W I
4	4576.64	U I	38	4583.07	Gd I	14	4592.52	Ru I
40	4577.17	V I	1.6	4583.10	Ce I	4	4592.53	Ni I
40	4577.69	Sm II	2	4583.17	Ta I	6	4592.58	W I
2.5	4577.78	Mo I	4	4583.78	V I	4	4592.67	Th I
34	4577.80	Dy I	2.5	4584.04	Nd II	6	4592.93	Er I
10 c	4578.07	Ho I	7	4584.24	Zr I	6 h	4592.94	Sc I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
20	4593.18	Cs I	3.0	4600.39	Pr	20	4606.51	Sm II
26	4593.54	Sm II	3.5	4600.44	W I	2.0	4606.52	Th II
1.5	4593.65	Th I	40	4600.75	Cr I	80	4606.62	Er I
60	4593.93	Ce II	4	4601.02	Cr I	120	4606.77	Nb I
2.5	4593.93	Pr II	32	4601.05	Gd II	3.0	4606.88	Sm II
750	4594.03	Eu I	4	4601.13	U II	650	4607.33	Sr I
100	4594.11	V I	2.5	4601.29	Tm II	9	4607.34	Au I
5	4594.45	Nd II	2.5	4601.37	Ce II	2.5	4607.38	Nd II
2.5	4594.59	Sm II	4	4601.42	Ta I	10 c	4608.00	Ho I
1.6 h	4594.63	Co I	5	4601.76	Ru I	3.0	4608.03	Gd II
8	4595.04	Os I	3.0	4602.05	La I	8	4608.09	Hf I
13	4595.16	Mo I	5	4602.06	Er I	2.5	4608.12	Rh I
38	4595.29	Sm II	5	4602.19	Ta I	5	4608.49	Ce I
6	4595.42	Th I	32	4602.57	Zr I	2.5	4608.58	Gd I
6	4595.59	Cr I	1.4	4602.63	Eu I	2.5	4608.58	Nb I
2.5	4595.87	Pr II	13 hl	4602.86	Li I	5	4608.67	Ho II
11	4596.55	Y I	2.0	4602.86	Nb I	2.5	4608.71	Mo I
7	4596.63	Tm I	3.5	4602.90	Th II	2.0	4609.15	Zr I
6	4596.71	Ru I	22	4602.93	Gd I	2.0	4609.29	Zr I
3.5	4596.73	Er I	2.5	4602.94	Fe I	13 cw	4609.32	Ho II
16	4596.74	Sm I	4	4603.12	Sm II		4609.52	Ho II
1.6 h	4596.90	Co I	4	4603.44	Tm II	1.8	4609.37	Ti I
6	4596.95	Pr	10	4603.66	U II	4	4609.38	Th II
20	4596.98	Gd II	2.0	4603.81	Pr	4	4609.53	Sc
12	4597.02	Nd II	6	4603.82	Nd I	2.5	4609.65	V I
8	4597.16	Os I	4 h	4604.10	Tb II	2.0	4609.83	Zr I
4	4597.17	Ce	15	4604.18	Sm II	3.0	4609.86	U
2.5	4597.88	Mo I	1.6	4604.21	Ce II	6	4609.87	Nd I
4 h	4597.90	Hf I	1.8 h	4604.28	Ta I	28	4609.88	Mo I
30	4597.91	Gd II	13	4604.42	Zr I	15	4609.92	W I
6	4598.13	Er I	2.0	4604.48	Ir I	4	4609.95	Sc I
2.0	4598.25	Mo I	5 h	4604.72	Sc	2.0	4610.11	Zr I
6	4598.35	Sm II	8	4604.80	Y I	4	4610.47	Ce I
2.5	4598.37	Yb II	3.5 h	4604.85	Ta I	2.0	4610.69	Nb I
6 h	4598.45	Sc I	3.0	4604.86	Tm I	5 h	4611.04	Gd I
44 d	4598.80	Hf I	7	4605.00	Ni I	4	4611.15	Mo I
	4598.92	Hf I	2.5	4605.04	Os I	5	4611.25	Sm I
38	4598.90	Gd I	4	4605.15	U II	6	4611.28	Er II
2.0	4598.95	Pr I	6	4605.36	Mn I	3.0	4611.44	U
1.6	4599.02	Ce	8 c	4605.39	Lu I	6	4611.56	Ce II
20	4599.02	Tm I	2.5	4605.48	Ce II	2.0	4611.74	V I
30	4599.08	Ru I	3.5	4605.66	Ru I	5	4611.87	Th
4	4599.16	Mo I	12	4605.73	Re I	3.0	4611.96	Tb I
5	4599.23	Ti I	2.0	4605.77	Hf II	12	4612.07	Pr II
2.5	4599.48	Nb I	14	4605.78	La II	3.0	4612.12	Nb I
4	4599.75	Ba I	5 h	4606.06	Gd I	80	4612.28	Dy I
15	4599.96	W I	8	4606.15	V I	2.0	4612.32	Ru I
4	4600.10	Cr I	2.0	4606.23	Ni I	2.0	4612.47	Nd II
10	4600.21	Nb I	30	4606.40	Ce II	2.0	4612.56	Th II
2.0	4600.37	Ni I	3.5 h	4606.45	Pr	3.5	4613.00	Y I

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
5	4613.02	Ce II	20	4620.86	Hf I	32	4629.10	Ho II
18	4613.32	W I	8	4621.38	Mo I	16	4629.34	Ti I
20	4613.37	Cr I	10	4621.38	Re I	5	4629.38	Co I
15	4613.37	Ho I	3.0	4621.72	Tm I	2.0	4629.43	Sm I
36	4613.39	La II	18	4621.94	Nd I	3.5	4629.91	Nd II
5	4613.50	Sm II	7	4621.96	Cr I	4	4630.02	Mo I
4	4613.83	Dy I	3.0	4622.43	U II	34	4630.11	Nb I
3.5	4613.98	Tm I	6	4622.49	Cr I	10	4630.21	Sm II
5	4613.99	Ho II	6	4622.70	Hf II	4 h	4630.61	Hf I
3.0	4614.47	Tm II	2.0	4622.76	Cr I	3	4630.82	Ce
48	4614.50	Gd I	3.0	4622.96	Ta I	8 c	4630.82	Re I
2.5cw	4614.66	Re I	0.6	4623.04	Co I	13	4630.90	Er II
4	4614.83	Dy I	40	4623.09	Ti I	3.5	4631.29	Nd I
2.5	4614.86	W I	2.5	4623.46	Mo I	17	4631.62	U I
2.0	4615.07	La I	3.0	4623.69	W I	11	4631.76	Th II
5	4615.20	Ce I	2.5	4623.90	Th II	15	4631.83	Os I
20	4615.44	Sm II	2.0	4624.14	Th II	6	4632.07	Tb I
8 bl	4615.6	Gd GdO	5	4624.21	Nd I	2.0	4632.18	Cr I
32	4615.69	Sm II	2.5	4624.24	Mo I	12	4632.28	Pr I
4 h	4615.92	Tb II	5	4624.41	V I	12	4632.32	Ce I
22	4615.95	Tm II	13	4624.42	Gd I	3.0	4632.64	Nd II
50	4616.14	Cr I	2.5	4624.78	Er II	6 h	4632.84	Ho I
18	4616.17	Nb I	1.6	4624.84	Ta I	4	4633.06	Ta I
7	4616.39	Ir I	30	4624.90	Ce II	3.5	4633.10	Mo I
2.0	4616.49	Sm II	1.6	4624.97	Sm II	2.5	4633.60	Ce II
2.5	4616.62	Mo I	2.0	4625.04	Th II	3.5	4633.77	Th I
15	4616.78	Os I	0.8 h	4625.78	Co I	60	4633.98	Zr I
5	4617.26	Dy II	2.5 h	4625.96	Re I	30	4634.24	Nd I
80	4617.27	Ti I	46	4626.19	Cr I	8	4634.26	Tm II
2.5	4617.49	Tb I	7 d	4626.32	Tb II	2.0	4634.64	Zr I
2.0	4617.73	Pr I	6	4626.33	Tm II	3.0	4634.77	Os I
2.5	4617.95	Mo I	19	4626.41	Zr I	6	4634.81	W I
2.0	4618.01	Pr	36	4626.47	Mo I	4 d	4634.87	Ti
11	4618.84	Ho I	4	4626.48	V I	8	4635.18	V I
2.5	4619.06	Tm II	5	4626.50	Nd I	12	4635.69	Pr I
6	4619.14	Gd I	6	4626.54	Mn I	14	4635.69	Ru I
3.0	4619.36	Tb II	7	4626.56	Tm II	6	4636.26	Sm II
28	4619.51	Ta I	9	4626.94	Tb II	3.5	4636.43	La II
8	4619.51	Th II	3.0	4626.97	Tm I	6 h	4636.59	Tb I
2.0	4619.52	Ti I	3.0	4627.05	Pr II	40	4636.64	Gd I
6	4619.55	Cr I	19	4627.08	U II	3 h	4636.74	Ce II
18	4619.77	V I	650	4627.22	Eu I	3.0	4636.99	Tb II
2.0bl	4619.85	Zr ZrO	8	4627.48	Mo I	3.5	4637.18	Cr I
36	4619.88	La II	2.0	4627.48	Nb I	3.5	4637.20	Nd I
1.2	4619.91	Rh	2.0	4627.72	Zr I	4	4637.77	Cr I
2.0	4619.98	Ba I	6	4627.98	Nd I	2.0bl	4637.78	Zr ZrO
11	4620.03	Dy II	120	4628.16	Ce II	5	4637.88	Ti I
22	4620.23	U I	11 c	4628.22	Ho I	5	4638.10	Nb I
1.0	4620.25	Sm II	24 c	4628.75	Pr II	5 c	4638.19	Ho II
3.5	4620.55	W I	3.5	4629.07	Zr II		4638.29	Ho II

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
5	4638.72 Nd II		3.5	4646.15 W I		3.5	4652.39 Nd I	
10	4639.00 Gd II		130	4646.17 Cr I		4	4652.71 Ho II	
5	4639.14 Nd I		4	4646.34 La I		40	4653.54 Gd I	
20	4639.37 Ti I		12	4646.40 Nd I		6 b	4654.03 Lu LuO	
4 d	4639.52 Cr I		10	4646.40 V I		9	4654.29 Ce II	
	4639.70 Cr I		18	4646.60 U II		24	4654.32 Ru I	
18	4639.56 Pr I		20	4646.68 Sm II		3.0	4654.38 Zr I	
18	4639.67 Ti I		2.0	4646.81 Cr I		12	4654.73 Nd I	
5	4639.71 Th II		4	4646.95 Nb I		3.0	4654.74 Cr I	
16	4639.95 Ti I		5	4646.99 Pr I		8	4654.99 Gd II	
16	4640.04 Gd I		8	4647.23 Tb I		9	4655.09 Tm I	
5	4640.05 Th II		3	4647.28 Ce		10	4655.13 Sm II	
5	4640.07 V I		3	4647.38 Ce II		16	4655.19 Hf I	
6	4640.13 Zr I		6	4647.51 La II		48	4655.50 La II	
7	4640.21 Pr I		6	4647.53 Sm II		2.0	4656.04 Ti I	
9	4640.61 Er II		60	4647.61 Ru I		2.5	4656.18 Ir I	
5	4640.74 V I		16	4647.64 Gd II		1.6	4656.19 Cr I	
5	4640.88 Ce I		8	4647.75 Ho II		60	4656.47 Ti I	
8	4641.00 Tb II		6	4647.81 Mo I		3.0	4656.68 Er II	
5	4641.06 Ce I		2.0	4648.13 Cr I		13	4657.44 W I	
20	4641.10 Nd I		16	4648.16 Sm II		8	4657.64 Zr I	
2.5	4641.23 Th I		10 h	4648.21 Lu I		100	4658.02 Lu I	
5	4641.66 U II		16 d	4648.59 Gd I		2.5	4658.09 Pr	
3.5	4641.80 W I			4648.70 Gd I		2.5	4658.18 Nb I	
3.0	4641.83 Os I		7	4648.65 La I		17 h	4658.32 Y I	
19	4641.98 Tb II		8	4648.66 Ni I		6	4658.38 Tb I	
60	4642.24 Sm II		9 h	4648.85 Lu I		3.0	4658.73 Pr I	
10	4642.56 W I		2.0	4648.87 Cr I		2.0	4658.73 Tb	
2.5	4642.70 Mo I		2.5	4648.89 V I		6	4658.89 Y I	
3.0	4642.96 Tm II		34	4648.95 Nb I		8 h	4659.03 Lu I	
7	4643.12 Tm I		2.5	4649.12 Mo I		4	4659.40 Ce	
3.5	4643.15 W I		8	4649.27 Nb I		3.0	4659.49 Zr I	
6	4643.17 Ce I		3.0	4649.46 Cr I		65	4659.87 W I	
2.0	4643.18 Rh I		26	4649.49 Sm I		2.5	4659.94 Ce II	
2.0	4643.31 Nb I		18	4649.67 Nd I		3.0	4660.70 La I	
10 c	4643.51 Pr II		22 c	4649.77 Ho II		5 h	4660.92 Pr I	
5 c	4643.68 Nb I		5	4649.89 Ce I		8	4661.12 Ta I	
170	4643.70 Y I		10	4650.02 Ti I		2.5	4661.23 W I	
5	4644.20 Ce II		3.0	4650.33 La I		15 c	4661.33 Ho II	
2.5	4644.58 Tm I		8	4650.52 Ce I		60 bl	4661.75 Lu LuO	
18	4644.83 Zr I		5	4651.05 Mo I		550	4661.88 Eu I	
17	4645.09 Ru I		8	4651.12 Cu I		6	4661.93 Mo I	
12	4645.19 Ti I		48	4651.28 Cr I		3.5	4661.97 W I	
10	4645.28 La II		5	4651.39 Ho		4	4662.49 Re I	
24 cw	4645.28 Tb II		18 c	4651.52 Pr II		32	4662.51 La II	
20	4645.40 Sm I		11	4651.56 Th II		4	4662.76 Dy I	
9 h	4645.47 Lu I		2.5	4651.99 Th II		17	4662.76 Mo I	
15	4645.77 Nd II		4	4652.08 La I		8	4662.80 Tb I	
16	4646.00 Gd I		70	4652.16 Cr I		1.8	4663.20 Th I	
12	4646.06 Pr II		9	4652.33 Re I		3.0	4663.24 Ce	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
3.5	4663.33	Cr I	4 h	4669.98	Th I	12	4679.07	Er II
7	4663.41	Co I	36	4670.40	Sc II	3.5	4679.11	Pr II
20	4663.56	Sm I	12	4670.49	V I	16	4679.18	Gd I
4	4663.75	U I	11	4670.56	Nd II	24	4680.04	Gd I
20	4663.76	La II	6	4670.74	Ce II	13	4680.13	Ce II
12	4663.82	Os I	32 d	4670.75	Sm I	40	4680.14	Zn I
6	4663.83	Cr I		4670.83	Sm I	4 h	4680.49	Sc
34	4663.83	Nb I	5	4670.82	Y I	65	4680.52	W I
6	4664.12	Hf II	13 h	4670.87	Gd I	3.5	4680.54	Cr I
4	4664.27	Gd II	5	4670.91	Ce I	2.5	4680.65	Th I
4 h	4664.45	Nd II	4	4671.10	Nd I	14	4680.74	Nd II
12	4664.65	Pr II	8	4671.41	U II	1.6	4680.87	Cr I
9	4664.68	Dy II	3.5	4671.58	Er I	2.5	4680.99	Ce II
8	4664.80	Cr I	2.5	4671.69	Mn I	22	4681.55	Sm I
5	4665.13	Sm II	14	4671.83	La II	24	4681.79	Ru I
2.5	4665.28	Ce	10	4671.90	Mo I	7 c	4681.87	Tb I
2.0	4665.33	Nb I	2.5	4671.99	Tm II	42	4681.88	Ta I
9	4665.43	Er II	24 c	4672.08	Pr II	80	4681.92	Ti I
5 c	4665.45	Tb I	44	4672.09	Nb I	12	4681.92	Tm I
3.0	4665.90	Cr I	30 bl	4672.31	Lu LuO	4	4682.02	Dy II
5	4666.01	Th II	25	4673.16	Er I	2.5	4682.31	Os I
2.5	4666.14	V I	2.5	4673.59	Nb I	5	4682.32	Re I
1.8	4666.22	Cr I	3.0	4673.62	Ba I	22	4682.32	Y II
26	4666.24	Nb I	7	4673.62	Dy II	4	4682.38	Co I
5	4666.45	Gd II	6	4673.66	Th I	5	4682.52	Tb I
6	4666.51	Cr I	2.0	4673.97	Nd I	2.0	4682.66	Nb I
2.5	4666.70	Tm II	6	4674.49	Ce I	8	4682.69	Sm II
2.5	4666.71	Ce II	110	4674.60	Sm II	2.5 c	4682.79	Tb II
4	4666.79	Th I	16 c	4674.62	Ho	6	4683.07	Gd I
11	4666.86	U II	8	4674.65	Ru I	6	4683.08	Ho I
6	4667.14	Zr I	170	4674.84	Y I	40	4683.33	Gd I
18	4667.22	Nb I	13	4675.03	Rh I	22	4683.42	Zr I
7	4667.47	Y I	2.5	4675.10	Tm I	26	4683.45	Nd I
2.5	4667.59	Er II	6	4675.12	Ti I	4	4683.54	W I
70	4667.59	Ti I	6	4675.32	Tm I	2.5	4683.83	Mo I
7	4668.17	Th I	40	4675.37	Nb I	2.0	4683.83	Yb II
4	4668.46	W I	5	4675.52	Nd I	16	4684.02	Ru I
6 hl	4668.48	Ag I	46	4675.62	Er II	9	4684.04	Nd I
18	4668.91	La II	5	4676.06	Th II	40 bl	4684.16	Lu LuO
1.6 h	4668.99	Ir I	5	4676.63	W I	6	4684.25	Zr I
2.0	4669.14	Ru I	8	4676.90	Tb I	2.5	4684.28	Yb I
12	4669.14	Ta I	70	4676.91	Sm II	1.8	4684.45	V I
2.0	4669.24	Hf I	6	4677.69	W I	24	4684.61	Ce II
4	4669.34	Cr I	3.0	4677.86	Tm II	4	4684.87	Ta I
50	4669.40	Sm II	80	4678.16	Cd I	5 c	4684.94	Pr II
4	4669.40	Tb I	5	4678.17	Pr II	5	4685.12	Tm I
8	4669.50	Ce II	5	4678.25	Gd I	24	4685.14	Nb I
42	4669.65	Sm II	5	4678.35	Y I	2.0	4685.19	Zr II
2.5	4669.87	Nb I	8	4678.48	Nb I	5	4685.23	Ce II
6	4669.98	Ru I	3.0	4679.04	W I	3.5	4685.27	Ta I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
2.5	4685.81 Mo I		6	4692.06 Os I		4	4700.44 Re I	
6	4685.83 Ho II		20	4692.50 La II		4	4700.49 Mo I	
6	4685.84 Ge I		8	4693.11 Tb II		3.0	4700.61 Cr I	
2.0	4686.10 Mo I		3.5	4693.21 Co I		3.5	4700.98 U	
1.2	4686.19 Th I		8	4693.35 Ta I		4	4701.16 Mn I	
2.5	4686.22 Ni I		3.0 h	4693.39 Tb II		8	4701.17 Ho II	
6 h	4686.41 Gd I		13	4693.63 Sm II		6	4701.32 Ta I	
2.0	4686.57 Zr I		3.5	4693.68 Ti I		6	4701.45 Ce	
6	4686.81 Ce		10	4693.73 W I		9	4701.69 Ho II	
1.8	4686.92 Ti I		3.0	4693.93 Mo I		6	4702.01 Ce	
2.5	4686.92 V I		5	4693.95 Cr I		4	4702.05 U II	
38	4687.18 Sm II		11	4694.09 Th II		3.0	4702.19 Er II	
200	4687.80 Zr I		65	4694.33 Gd I		1.2	4702.32 Th II	
16	4687.81 Pr I		5	4694.51 Nb I		20	4702.41 Tb II	
2.5	4687.86 Re I		6	4694.88 Ce II		3.0	4702.47 W I	
13	4688.12 Gd I		4 d	4694.90 Th II		8	4702.52 U II	
5	4688.19 Ho II			4695.04 Th I		3.0	4702.64 La I	
10	4688.22 Mo I		2.5 c	4694.99 Re I		7	4703.02 Mg I	
44	4688.45 Zr I		2.0	4695.04 Zr I		16	4703.13 Gd I	
1.2	4688.55 Nd I		2.0	4695.15 Cr I		12	4703.28 La II	
3.0	4688.63 Er II		26 bl	4695.46 Lu LuO		11	4703.57 Nd II	
8	4688.63 Tb II		5	4695.47 Nb I		4	4703.99 Th I	
38	4688.73 Sm I		16	4695.49 Gd I		55	4704.40 Sm II	
1.8	4688.84 Ta I		26	4695.77 Pr I		6	4705.04 Re I	
7	4688.89 Ce I		16	4696.44 Nd I		10	4705.76 Th II	
14	4689.07 U II		2.5	4696.51 Mo I		6	4706.06 Mo I	
8	4689.20 Th II		6	4696.52 Ce I		6	4706.09 Ta I	
6	4689.37 Cr I		15	4696.81 Y I		10 c	4706.14 Nb I	
1.6	4689.50 Ce II		2.0	4696.94 Ti I		4	4706.16 V I	
4	4689.57 Sm II		5	4697.06 Cr I		2.0	4706.17 W I	
4	4689.77 Dy II		6	4697.17 Er II		3.0	4706.25 Th II	
7	4689.77 Y I		40	4697.42 Gd I		40	4706.54 Nd II	
24	4690.11 Ru I		7	4697.47 Nb I		6	4706.57 V I	
2.0	4690.17 Ce II		5	4698.29 Sc II		12	4706.96 Nd I	
9	4690.35 Nd I		0.9	4698.38 Co I		12	4706.97 Sc I	
2.5	4690.50 Ce II		20 d	4698.46 Cr I		4	4707.01 Ce I	
1.2	4690.64 Th			4698.62 Cr I		50	4707.26 Mo I	
4	4690.71 Ce I		3.0	4698.63 W I		5	4707.28 Ce I	
2.0	4690.80 Ti I		10	4698.71 Dy II		5	4707.54 Pr II	
3.0	4690.86 Mo I		16	4698.76 Ti I		9	4707.79 Zr I	
3.0	4691.07 Th II		9	4699.01 Hf I		4	4707.94 Ce II	
9	4691.11 Tm I		12	4699.34 Sm II		6	4707.94 Pr II	
8	4691.16 Gd I		8	4699.63 La II		11	4707.94 Tb II	
8	4691.18 La II		3.0	4699.72 Hf II		18 bl	4708.00 Lu LuO	
16	4691.34 Ti I		4 h	4700.11 Zr I		16	4708.04 Cr I	
13	4691.62 Ba I			4700.18 Zr I		1.2	4708.10 Th II	
1.2	4691.64 Th I		4	4700.14 Th II		6	4708.16 Pr II	
2.0	4691.73 Zr I		3.0	4700.26 La I		3.0	4708.19 La I	
12	4691.90 Ta I		5	4700.41 W I		12	4708.22 Mo I	
4	4692.06 Ce II		3.0	4700.43 Ba I		20	4708.29 Nb I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum
7 bl	4708.60	Be BeO
2.5	4708.69	Er I
3.5 h	4708.84	Hf I
3.0	4708.85	Y I
2.0	4708.88	Ir I
12	4709.34	Sc I
120	4709.48	Ru I
12	4709.52	Pr I
16	4709.71	Nd II
13	4709.72	Mn I
19	4709.78	Gd I
14	4709.84	Ho II
2.0	4710.00	Ce
160	4710.08	Zr I
10	4710.19	Ti I
2.5	4710.34	W I
6	4710.56	V I
6	4710.64	Sm II
2.5	4711.19	W I
7	4711.39	Ho I
14	4711.92	Zr I
5	4711.98	Gd II
5	4712.44	Th II
4	4712.49	W I
3.0	4712.80	Gd II
6	4712.93	La II
2.5	4713.05	Nb I
28	4713.06	Sm II
8	4713.10	Pr I
6	4713.43	Zr I
11	4713.50	Nb I
2.0	4713.59	Eu I
18	4714.00	Ce II
5	4714.12	V I
8	4714.15	Pr I
10	4714.42	Ni I
2.5	4714.51	Mo I
8	4714.62	Sm II
9	4714.81	Ce II
13	4715.26	Sm II
2.0	4715.30	Ti I
2.0	4715.43	Th II
16	4715.59	Nd II
3.5	4715.68	U I
2.0	4715.78	Ni I
5	4715.83	Nb I
2.5	4715.89	V I
4 w	4716.07	Tb II
75	4716.10	Sm I
15	4716.44	La II
3.0	4716.70	Lu I
2.5	4716.86	W I
28	4717.07	Sm I
5	4717.08	Nd II
15 c	4717.52	Ho I
3.0	4717.59	La II
10	4717.62	Zr I
4	4717.69	V I
22	4717.72	Sm II
8	4717.88	Ce II
17	4717.92	Mo I
5	4718.02	Nb I
20	4718.33	Sm II
20	4718.43	Cr I
5	4718.61	Th II
2.5	4718.63	W I
3.0	4718.64	Sm I
3.0 d	4718.71	Er II
3.0	4718.88	Mo I
20	4719.02	Nd I
3.5 h	4719.10	Hf II
18	4719.12	Zr I
28	4719.84	Sm II
12	4719.94	La II
3.0	4719.98	Th II
3.5	4720.12	Sm II
2.5	4720.40	W I
6 b	4720.86	Lu LuO
2.5	4720.92	Ru I
1.6	4721.00	Rh I
9	4721.23	Dy I
3.0	4721.39	Sm II
10	4721.46	Gd I
3.0	4721.51	V I
2.5	4722.09	Th I
100	4722.16	Zn I
	4722.19	Bi I
60 c	4722.55	Bi
	4722.83	Bi
32	4722.28	Sr I
3.0	4722.30	Ce II
6	4722.62	Ti I
22	4722.71	Er I
13	4722.73	U II
3.0	4722.86	V I
4	4722.88	Ta I
2.0	4723.06	Mo I
4	4723.10	Cr I
6	4723.17	Ti I
3.0	4723.31	Ce II
7	4723.44	Th II
9	4723.78	Th I
4	4723.80	Nb I
8	4724.26	Tm I
1.4	4724.32	Ce I
16	4724.35	Nd II
4	4724.42	Cr I
3.0	4724.43	La II
8	4724.54	Er II
4	4724.76	Th I
3.5	4724.85	Ce I
10	4725.09	Ce II
5	4725.14	W I
1.6	4725.34	Mo I
5	4725.85	Y I
2.5	4725.93	Re I
13	4726.02	Sm II
11	4726.08	Yb II
6 h	4726.20	Lu I
2.5 d	4726.32	Th II
	4726.47	Th
8	4726.45	Ba I
2.5	4726.55	Nd I
7	4727.14	Dy II
4	4727.15	Cr I
4	4727.33	Nb I
14	4727.48	Mn I
1.4	4727.59	Ce I
6	4727.60	Re I
0.7	4727.94	Co I
4	4728.16	Tb II
20	4728.42	La II
80	4728.42	Sm I
14	4728.47	Gd II
14	4728.53	Y I
5	4728.63	Pr II
8	4728.64	Gd I
4 c	4728.72	Ho II
20	4728.77	Sc I
5	4728.86	Ir I
14	4729.04	Er I
2.5	4729.11	Th I
8	4729.14	Mo I
50	4729.23	Sc I
3.0	4729.53	V I
8	4729.65	W I
2.0	4729.72	Cr I
3.5	4729.87	Th II
8	4730.12	Ta I
7	4730.13	Ce II

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
5	4730.31	Nb I	4	4738.00	Ho II	1.8	4746.63	V I
2.0	4730.38	V I	2.0	4738.04	Os I	13	4746.93	Pr II
16	4730.69	Pr I	6	4738.11	Gd I	14	4747.14	Ce II
10	4730.71	Cr I	4	4738.35	Os	2.0	4747.68	Ti I
2.0	4731.14	Zr I	2.5 h	4738.35	Ta I	7	4747.80	Tb I
5	4731.17	Ti I	2.5	4738.40	Ru I	6	4748.38	Re I
12	4731.33	Ru I	3.0	4738.58	Hf I	3.0	4748.52	V I
3.5 h	4731.37	Hf II	10	4739.11	Mn I	28	4748.73	La II
55	4731.44	Mo I	3.5	4739.12	Ce II	2.5	4749.03	Nd
8	4731.60	Er II	120	4739.48	Zr I	2.5	4749.03	Re I
10	4731.60	U II	9	4739.53	Ce II	4 c	4749.09	Ho II
12	4731.77	Nd I	8	4739.93	Tb I	7 bl	4749.11	Lu LuO
18	4731.85	Dy II	14	4740.16	Ta I	3.0 h	4749.15	Gd I
2.0	4731.86	Ir I	44	4740.28	La II	2.0	4749.19	Th I
4 h	4732.30	Sc I	1.8	4740.50	Eu I	1.4	4749.50	Ce II
26	4732.33	Zr I	15	4740.53	Th II	2.5	4749.56	Nd II
5 h	4732.37	Y I	5	4740.61	Nb I	4	4749.68	Co I
20	4732.60	Gd II	80	4741.02	Sc I	17 c	4749.70	Nb I
1.0	4732.66	Th II	1.0	4741.31	Th I	6	4749.75	Nd I
2.5	4732.80	Os I	7	4741.40	Y I	1.6	4749.95	Th I
50	4733.34	Tm I	2.5	4741.50	Pr I	8	4750.39	Mo I
4	4733.43	Ti I	4	4741.64	Ce II	4	4750.41	La I
6	4733.48	Nb I	5	4741.72	Sm II	15	4750.72	Sm I
9	4733.52	Ce II	22	4741.92	Sr I	2.5	4750.75	Tm II
10	4733.52	Ru I	32	4742.04	Ho II	2.0	4750.84	Ce I
2.0	4733.75	Pr I	2.0	4742.11	Ti I	3.5	4750.98	V I
8 c	4733.89	Nb I	2.0	4742.26	Th II	4	4751.40	Ho I
3.0	4733.95	Ce I	2.0	4742.63	V I	5	4751.42	Nb I
60	4734.10	Sc I	15	4742.79	Ti I	2.0	4751.53	Ce
4 c	4734.18	Pr II	3.0	4742.94	Zr I	12	4751.55	Er II
6 cw	4734.20	Tb II	3.0	4743.02	Ru I	2.5	4751.56	V I
3.0	4734.36	Zr I	34	4743.09	La II	3.5	4751.91	Zr I
4	4734.43	Gd II	3.0	4743.53	U I	6	4752.08	Cr I
1.6	4734.68	Ti I	38	4743.65	Gd I	2.5	4752.16	Os I
3.5	4734.70	Ce I	3.5	4743.68	Th II	3.0	4752.21	W I
0.6	4734.83	Co I	120	4743.81	Sc I	2.5	4752.24	Ce II
3.0	4734.90	Nd I	5	4743.84	Nb I	11	4752.41	Th II
10 bl	4735.00	Lu LuO	4	4743.89	Os I	40 cw	4752.51	Tb II
6	4735.08	Sc	9	4744.16	Pr I	2.0	4752.58	Ce I
4	4735.33	Nb I	6	4744.62	Nb I	3.0	4752.58	W I
2.0	4735.35	Ce II	8	4744.82	Ce	13	4752.79	Y I
24	4735.75	Gd I	8	4744.93	Pr II	5	4753.05	Zr I
1.6	4736.20	Nd II	6	4745.11	Rh I	20	4753.16	Sc I
5	4736.49	Nb I	6	4745.28	Er I	2.0	4753.39	W I
22	4736.69	Pr I	1.6	4745.31	Cr I	3.0	4753.93	V I
1.6	4736.78	Fe I	2.0	4745.57	W I	80	4754.04	Mn I
4	4736.97	Er II	48	4745.68	Sm II	0.7	4754.36	Co I
28	4737.28	Ce II	4	4745.79	Dy II	6	4755.01	Dy II
12	4737.35	Cr I	10	4745.82	Gd I	2	4755.32	Nb I
70	4737.65	Sc I	3.5	4745.93	Ta I	3.0 d	4755.35	Gd II

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
	4755.50 Gd II		9	4762.73 Pr II		6	4773.44 Mo I	
4	4755.37 Sm II		16	4762.78 Zr I		6	4773.72 Hf I	
5	4755.54 Ce II		3.0	4763.10 Os I		3.5	4773.91 W I	
1.0	4755.58 Rh I		4	4763.57 Ho II		20	4773.94 Ce II	
8	4755.73 U II		4	4763.62 Nd II		3.0	4774.00 Ru I	
4	4755.85 Nd I		2.0	4763.67 Re I		11	4774.15 Sm II	
6 d	4755.98 Pr		12	4763.82 Gd I		3.0	4774.22 Mo I	
	4756.13 Pr II		7	4763.87 Nd II		5	4774.27 Th II	
28	4756.11 Cr I		6	4763.90 Ce II		5	4774.80 Dy I	
6	4756.23 Ru I		1.4	4763.95 Ni I		2.0	4774.89 Hf I	
2.5	4756.46 Ir I		4 bl	4764.22 Lu LuO		3.0	4775.08 Ce I	
20	4756.51 Ta I		4	4764.29 Cr I		1.8 c	4775.17 Pr	
3.0	4756.52 Ni I		3.0	4764.35 Th I		5	4775.66 Mo I	
12	4756.80 U I		1.8	4764.40 Ru I		12 h	4775.80 Dy I	
11 c	4757.01 Ho I		6	4764.42 Mo I		3.0	4776.32 Co I	
5	4757.48 V I		2.5	4764.47 Tb II		12	4776.34 Mo I	
14	4757.55 W I		2.0	4764.72 Ce I		10	4776.36 V I	
3.0	4757.58 Hf I		6 c	4765.22 Pr II			4776.52 V I	
2.5	4757.78 W I		24	4765.86 Mn I		2.0	4777.19 Th I	
10	4757.84 Ce II		4	4766.33 Ti I		6	4777.48 Ho II	
42	4757.84 Ru I		40	4766.43 Mn I		1.6	4777.62 Nb I	
7 c	4757.94 Pr II		7	4766.51 Hf I		3.5	4777.72 Nd II	
1.2	4757.96 Ir I		1.0	4766.60 Th I		20	4777.85 Sm II	
4	4758.03 Ta I		1.8	4766.63 Cr I		3.0	4778.10 U	
3.5 h	4758.12 Th I		4	4766.63 V I		6	4778.16 Ir I	
28	4758.12 Ti I		5	4766.81 Nb I		6	4778.26 Ti I	
2.0	4758.21 W I		14	4766.89 La I		2.0	4778.30 Th I	
4	4758.26 Gd I		44	4767.24 Gd I		3.5	4778.36 Tb II	
4	4758.44 Tb II		1.8	4767.78 W I		1.2	4778.40 Nd I	
3.5	4758.50 Mo I		2.5	4767.86 Cr I		3.5	4778.80 Tb II	
30	4758.70 Gd I		0.9	4768.08 Co I		2.5 c	4779.20 Pr II	
4	4758.83 Re I		3.0	4768.66 U I		22	4779.35 Sc I	
2.0	4759.10 Nd I		9	4768.77 Ce II		3.5	4779.42 Ho I	
28	4759.28 Ti I		11	4768.98 Ta I		10	4779.46 Nd I	
16	4759.66 Er II		6	4769.26 U II		1.0	4779.60 Th	
5	4759.90 Tm I		8	4769.30 Ru I		4	4779.63 U II	
1.4	4759.92 Ce II		2.5	4769.77 Ti I		4	4780.01 Co I	
5	4760.02 Dy II		6	4770.20 Nd I		1.4	4780.18 Y I	
60	4760.19 Mo I		11	4770.20 Sm I		3.0	4780.19 U II	
4	4760.19 Tb II		3.0	4770.43 La I		2.5	4780.23 Ce II	
75	4760.27 Sm I		3.0	4771.11 Co I		1.6	4780.52 W I	
1.8	4760.45 Nd I		2.0	4771.73 Nd		8	4780.94 Ta I	
10	4760.74 Gd I		2.5	4771.85 Nb I		6 d	4780.99 Gd I	
34	4760.98 Y I		6	4771.94 Dy I			4781.13 Gd I	
5	4761.11 Th II		1.6	4772.26 Nd I		10	4781.04 Y I	
14	4761.53 Mn I		75	4772.31 Zr I		8 c	4781.19 Ho I	
3.0	4762.37 Tb II		8	4772.70 U II		4	4781.72 Ti I	
60	4762.38 Mn I		3.5	4772.88 Nd II		7	4781.84 Sm II	
4	4762.39 Ho II		1.8	4773.15 Ru I		10 h	4781.89 Yb I	
6	4762.66 Er II		6	4773.25 Nb I		17	4781.92 Gd I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
12	4782.74 Hf I		4 cw	4789.91 Tb II		6	4800.90 Ce	
1.8	4782.76 Th II		2.0	4789.92 Tm II		10	4801.03 Cr I	
7	4782.92 Ho I		5	4789.96 Nb II		13	4801.05 Gd II	
4	4782.94 Mo I		16	4789.96 Sm I		8	4801.15 Pr II	
60	4783.10 Sm I		3.5	4790.06 U I		3.0	4801.87 Tb II	
10	4783.35 Pr II		3.0	4790.72 Hf II		2.0	4802.45 Nb I	
75	4783.42 Mn I		4	4791.15 Gd II		3.0	4802.58 Gd II	
3.5 d	4783.47 Gd I		10	4791.30 Dy I		1.6	4803.49 Th II	
	4783.56 Gd I		19 c	4791.42 Re I		3.5	4803.54 Gd II	
6	4783.80 Nd II		4	4791.48 Ho II		0.9	4803.96 Th II	
3.5	4783.94 Ce		9	4791.50 Sc I		14	4804.04 La II	
1.2	4784.04 Th I		24	4791.58 Sm II		4	4804.31 Y I	
4	4784.27 Ru I		10	4792.49 Ti I		6	4804.81 Y I	
14	4784.32 Sr I		8	4792.51 Cr I		5	4804.88 Ru I	
28	4784.62 Gd I		3.0	4792.59 Eu I		1.6 h	4804.90 Sm II	
2.5	4784.78 Ce I		5	4792.60 Au I		1.4	4804.91 Mo I	
18	4784.92 Zr I		5	4792.74 Mo I		2.5	4805.10 Ti II	
7	4785.12 Mo I		9	4792.86 Co I		10	4805.43 Ti I	
14	4785.42 Lu II		4	4793.16 Ce		2.5	4805.58 Mo I	
2.0	4785.70 Nb I		3.0	4793.28 Zr I		2.5	4805.82 Gd II	
36	4785.86 Sm I		5	4793.41 Mo I		22	4805.87 Zr I	
3.0	4785.91 U		1.6	4793.82 Mo I		4	4805.93 Ce I	
3.5	4786.06 Nd II		60	4793.99 Os I		1.6	4806.19 Ru I	
6 c	4786.29 Ho I		3.0	4794.38 Ru I		3.5	4806.62 Nd I	
3.0	4786.46 Mo I		2.5	4794.96 Zr I		3.0	4806.68 Zr I	
8	4786.51 V I		9	4795.50 Er II		2.0	4807.00 Ni I	
3.0	4786.54 Ce I		3.0	4795.57 Ru I		3.0	4807.06 Nb I	
4	4786.54 Ni I		3.0	4795.67 Ir I		1.0	4807.14 Ir I	
13	4786.58 Y II		4	4795.92 Ho II		5	4807.37 W I	
10	4786.61 Yb II		4	4796.22 Ti I		20	4807.45 Gd I	
2.0	4786.64 Ta I		8	4796.52 Mo I		2.0	4807.48 Tm I	
10	4786.75 Gd I		2.5	4796.69 La II		10	4807.53 V I	
18	4786.78 Tb I		10	4796.92 V I		2.5	4807.68 Ce I	
14	4786.89 Y I		10	4797.15 Nd II		5	4807.95 Dy I	
4	4786.91 Gd II		2.5	4797.55 W I		4 h	4808.01 Gd I	
8	4786.94 Dy II		3.0	4797.98 Ti I		2.5	4808.09 Mo I	
4	4787.14 Ce		4	4798.44 Ru I		3.5	4808.13 Th I	
1.8	4787.40 Nd I		5 h	4798.87 Ho I		2.5	4808.19 Pr I	
2.5	4787.94 W I		15	4799.30 Y I		3.0	4808.50 Ce I	
1.6	4788.18 Mo I		5	4799.42 Nd II		4	4808.53 Ti I	
6 h	4788.18 Pd I		1.4	4799.77 V I		2.5	4808.68 Tm I	
1.4	4788.28 Pr I		10	4799.80 Ti I		14	4809.01 La II	
5	4788.43 Ce I		140	4799.92 Cd I		4	4809.37 Nb I	
2.0	4788.43 W I		8	4799.92 W I		2.0	4809.47 Ir I	
14	4788.67 Zr I		1.2	4799.94 Pr II		12	4809.47 Zr I	
3.5	4789.11 Zr I		2.5	4800.00 La I		4	4810.23 Dy I	
16	4789.32 Cr I		1.0	4800.18 Th II		2.0	4810.49 Rh I	
3.0	4789.39 Th I		2.0	4800.25 La I		140	4810.53 Zn I	
14	4789.41 Nd II		24	4800.50 Hf I		6 c	4810.60 Nb I	
3.0	4789.69 Ce II		3.0	4800.68 Dy I		3.0	4810.90 U I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
7	4811.06	Mo I	18	4820.42	Ti I	1.0	4831.60	Th I
2.0	4811.08	Ti I	2.5	4820.61	Ce I	11	4831.64	V I
20	4811.34	Nd II	1.4	4820.90	Th II	3.5 c	4832.07	Pr II
48	4811.88	Sr I	0.9	4821.29	Th II	36	4832.08	Sr I
3.5	4812.25	Ti I	30	4821.69	Gd I	5	4832.18	Ta I
20	4812.75	Ta I	10	4822.13	Y I	11	4832.28	Nd II
5	4812.79	Dy I	1.4	4822.42	Mo I	6	4832.31	Ho II
3.0	4812.92	Ho II	10	4822.54	Ce I	7	4832.41	Dy I
6	4813.48	Co I	2.0	4822.86	Th I	9	4832.43	V I
2.5	4813.50	Tm I	8	4822.98	Pr II	5	4832.80	Th II
2.0 d	4813.73	Th I	1.8	4823.20	Th II	3.0	4832.92	Mo I
	4813.89	Th I	16	4823.31	Y II	6	4833.00	Ru I
10	4813.77	Tb I	80	4823.52	Mn I	1.4	4833.02	V I
2.0	4813.80	Os I	2.5	4823.61	Th I	3.5	4833.32	Ho I
4	4814.34	Pr II	18	4824.06	La II	4	4833.32	Sm II
1.4	4814.47	Mo I	1.2	4824.18	Nd II	5	4833.37	Nb I
16	4815.04	Zr I	24	4824.29	Zr I	10	4833.67	Sc I
8	4815.05	Lu I	9	4824.99	Dy I	3.5	4833.78	Dy II
2.0	4815.50	Os I	8	4825.43	Ta I	2.0	4833.96	Mo I
22	4815.52	Ru I	2.0	4825.46	Ti I	3.5	4834.04	Ce I
60	4815.63	Zr I	30	4825.48	Nd II	3.0	4834.19	Hf I
44	4815.81	Sm II	2.0	4826.66	Os I	8	4834.23	Gd II
4	4815.96	Os I	3.0	4826.71	Th I	8	4834.62	Sm II
9	4816.01	Sm II	2.0	4826.88	La II	2.0	4834.74	Er II
2.0	4816.11	W I	2.0	4826.99	Tm II	2.5	4835.02	W I
8	4816.38	Nb I	3.0	4827.25	Pr I	12	4835.26	Gd I
2.0	4816.40	Yb I	10	4827.28	Sc I	4	4835.63	Ce II
2.0	4816.82	W I	10	4827.45	V I	2.5	4835.66	Nd I
5	4816.83	Gd I	2.0 d	4827.57	Nd I	2.5	4835.76	Tm I
2.5 h	4817.17	La I		4827.74	Nd I	6	4835.98	Nd II
3.0	4817.17	Nd II	16	4828.04	Zr I	3.5	4836.13	Ti I
2.5	4817.21	Hf II	2.0	4828.47	Mo I	5	4836.62	Nd I
1.6	4817.34	Ru I	4	4828.58	Nd II	6	4836.67	Ce I
7 bl	4817.38	Y YO	3.0	4828.67	Er I	3.5	4836.67	Sm II
5 h	4817.51	Pd I	8	4828.91	Dy I	1.2	4836.86	Cr I
2.0	4817.70	Mo I	2.0	4828.97	Tm I	2.0	4836.95	Yb II
12 bl	4818.20	Y YO	2.0 h	4829.03	Ni I	4 c	4837.04	Pr II
3.5	4818.65	Th II	2.5 h	4829.30	Eu I	6	4837.23	Hf I
5	4818.87	Hf I	4	4829.30	Nb I	2.5	4837.47	Yb I
2.0	4818.96	Nd II	9	4829.38	Cr I	2.5	4837.49	Ce I
8	4819.05	Dy I	2.0	4829.51	Er I	6	4837.59	Tb II
32	4819.25	Mo I	13	4829.57	Sm II	2.0	4837.62	Nb I
8	4819.53	Ta I	5	4829.69	Dy II	4	4837.65	Sm II
4	4819.54	U II	4	4829.94	Gd I	2.0	4837.99	Nb I
1.2	4819.64	Nd II	4	4830.33	Eu I	1.2	4838.11	Mo I
12	4819.64	Y I	32	4830.51	Mo I	9	4838.78	Zr I
4.0	4820.03	Ce I	3.5	4831.12	Th I	5	4838.98	Zr I
2.5	4820.25	Yb II	8	4831.14	Er II	4	4839.01	Ru I
18	4820.34	Er II	1.8	4831.18	Ni I	5	4839.15	Y I
12	4820.34	Nd II	6	4831.20	Tm II	17	4839.44	Sc I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
6	4839.52 La I		28	4848.32 Sm I		2.0	4857.37 Pr I	
3.5	4839.54 Pr II		2.5	4848.36 Th I		13	4857.43 Er I	
1.4	4839.59 Mo I		8 c	4848.37 Nb I		14 bld	4857.79 Sc ScO	
5 c	4839.62 Lu II		6	4848.47 Ti I			4858.09 Sc ScO	
1.6	4839.77 Ru I		3.5 c	4848.55 Pr II		7	4858.08 U II	
65	4839.87 Y I		1.4	4848.81 V I		0.9	4858.09 Th II	
4	4840.01 La II		8	4848.83 Er II		3.5	4858.22 Mo I	
8	4840.27 Co I		3.0	4849.04 Th II		3.0	4858.33 Th	
2.5	4840.39 Tb I		9	4849.06 Nd II		3.0	4858.41 Hf I	
2.5 h	4840.47 Eu I		4 h	4849.64 Eu I		5	4858.47 Er II	
4	4840.47 Sc I		5	4849.91 Ce I		1.4	4858.59 Pr	
3.5	4840.48 Th II		1.8	4850.19 Ce		3.5	4858.72 Ce II	
2.5	4840.74 Pr		6	4850.44 Th II		3.0	4858.87 Tb II	
1.0	4840.77 Ir I		4	4850.58 La II		24	4859.02 Nd II	
4	4840.84 Th I		1.6	4850.61 Hf I		2.5	4859.04 Pr II	
42	4840.87 Ti I		6	4850.82 La I		7	4859.22 Gd I	
1.6	4841.45 Zr I		1.0	4851.16 Yb II		10	4859.24 Hf I	
100	4841.70 Sm I		18	4851.36 Zr I		6	4859.48 Ce I	
8	4841.78 Dy		24	4851.48 V I		9	4859.55 Sm II	
6	4842.04 Er I		5	4851.63 Rh		2.5	4859.58 Nd I	
4	4842.15 Nb I		3.0	4851.64 Er II		6	4859.68 U II	
1.8	4842.43 Rh I		2.0 d	4851.75 Tm I		2.0	4859.75 Fe I	
4	4842.48 U I			4851.90 Tm II		28	4859.84 Y I	
3.0 c	4842.69 Tb II		3.0	4852.17 Ta I		2.0	4860.05 Mo I	
4	4843.03 Ce I		4	4852.62 Ce I		5	4860.39 Ho I	
0.9	4843.46 Co I		8	4852.68 Sc I		28	4860.91 La II	
80	4843.83 W I		34	4852.69 Y I		8	4861.02 U II	
2.0	4843.87 Os I		1.2	4852.86 Th I		1.4	4861.20 Cr I	
4	4843.99 Rh I		4	4853.12 Er II		1.0	4861.22 Th I	
3.5	4844.17 Th II		7	4853.33 Nd I		3.5	4861.60 Er II	
32	4844.21 Sm II		3.5	4853.61 Ce I		2.5	4861.73 Ce I	
2.5	4844.29 Ce		3.0	4853.68 Pr I		2.0	4861.77 Nd I	
2.0	4844.32 Mn I		4	4854.09 W I		7	4861.78 Gd I	
10	4844.56 Ru I		10	4854.25 Y I		6	4861.84 Cr I	
1.4	4844.57 Th II		12	4854.36 Sm II		7	4861.87 Ru I	
3.0	4844.89 Tb II		3.0	4854.42 Er II		10	4862.59 Gd I	
1.6	4845.17 Mo I		2.0	4854.56 Ru I		2.5	4862.61 V I	
4	4845.17 Nb I		3.0	4854.81 Tb I		2.5	4863.08 W I	
1.6	4845.38 Ir I		75	4854.87 Y II		22	4863.17 Th II	
8	4845.52 Ce I		2.0	4854.95 La I		8 d	4863.20 Ce CeO	
46	4845.68 Y I		5	4855.04 Sr I			4863.26 Ce I	
1.0	4845.97 Pr		3.0	4855.31 Nd I		6	4863.27 Hf I	
1.6	4846.35 Zr I		4	4855.41 Ni I		3.0	4864.18 Ti I	
6	4846.45 Ta I		3.5	4855.54 Ho II		36	4864.74 V I	
5	4846.57 Ce II		26	4856.01 Ti I		4	4864.78 Nd	
6	4847.66 U II		4	4856.17 Gd I		16	4865.02 Gd II	
8	4847.68 Sc I		4	4856.24 Dy II		5	4865.24 Pr II	
12	4847.75 Ce I		2.0	4856.54 Tb II		1.6	4865.36 Lu II	
14	4847.76 Sm II		4	4856.70 Y I		3.5	4865.48 Th I	
10	4848.10 Gd I		6	4856.72 Gd I		10	4865.60 Os I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
14	4866.06	Zr I	2.0	4876.12	Nd II	3.5	4885.15	U I
3.0	4866.27	Ni I	2.5	4876.12	Tb II	3.0	4885.78	Cr I
16	4866.74	Nd I	3.0	4876.26	Pr II	1.6	4885.96	Cr I
7	4867.62	Eu I	20	4876.32	Sr I	2.5	4886.05	Pr II
4	4867.84	Nd II	4	4877.00	Th II	1.8	4886.13	Ce
17	4867.88	Co I	6	4877.58	Hf I	4	4886.28	Y I
28	4868.00	Mo I	8 c	4877.82	Pr II	3.0	4886.30	Er II
4	4868.05	Dy II	5 h	4878.13	Ca I	2.5	4886.33	U II
18	4868.26	Ti I	1.2	4878.22	Fe I	2.0	4886.47	Mo I
0.9	4868.27	Th II	2.5	4878.28	W I	3.5	4886.65	Y I
3.0	4868.64	Ce I	3.0	4878.33	Er II	38	4886.91	W I
6	4868.70	Sr I	1.8	4878.37	Mo I	11	4887.01	Cr I
3.0	4868.86	U I	2.0	4878.73	Th I	2.0	4887.61	La I
0.9	4868.87	Th I	5	4878.86	La I	10	4888.08	Dy I
6	4868.99	Nb I	1.0 c	4879.12	Pr II	1.6	4888.39	W I
46	4869.15	Ru I	1.2	4879.14	Ta I	1.6	4888.53	Cr I
4	4869.20	Mo I	2.0	4879.20	Tm I	3.0	4888.86	Er I
4	4869.27	Nd I	1.2	4879.53	Pt I	12	4889.10	Nd II
2.0	4869.33	Pr I	4	4879.65	Y I	220 cw	4889.14	Re I
8	4869.98	Sm II	4	4879.79	Nd I	2.5	4889.19	Gd I
8	4870.04	Gd I	2.5	4879.90	Er II	1.6	4889.22	Mo I
22	4870.14	Ti I	9	4880.16	Dy I	4	4889.32	Dy II
2.5	4870.56	La I	4	4880.56	V I	4	4889.59	Ce I
12	4870.80	Cr I	2.5	4880.91	Ti I	3.0 c	4889.67	Ho II
1.6	4871.26	V I	8	4881.08	Gd I	8	4890.11	Dy II
6	4871.32	Fe I	8	4881.15	Tb II	5	4890.26	Pr II
3.0	4871.44	Nd I	9	4881.24	Zr I	1.6	4890.29	W I
11	4871.50	Gd I	6	4881.36	Gd I	19	4890.70	Nd II
1.8	4871.70	Ta I	2.5	4881.54	Ce I	7	4890.75	Nb I
14	4872.10	Er II	55	4881.56	V I	3.5	4890.77	Fe I
3.5	4872.15	Fe I	2.5	4881.92	Gd II	1.6	4890.89	W I
1.4	4872.28	Tm II	1.0	4881.94	Ta I	20	4891.07	Nd I
3.0	4872.49	Er II	2.5	4882.25	Pr I	8	4891.50	Fe I
30	4872.49	Sr I	4	4882.35	Ti I	2.0	4891.59	Tm I
3.0	4872.91	Th I	16	4882.46	Ce II	2.0	4891.60	V I
1.6	4872.94	Hf I	1.6	4882.72	Co I	2.5	4891.90	Ce II
0.8	4873.19	Sm II	2.5	4882.88	Nd II	1.2	4891.94	Sm II
3.0	4873.34	Gd II	8	4883.19	Gd I	10	4891.98	Sr I
1.6	4873.44	Ni I	9	4883.60	Zr I	6 bl	4892.1	Gd GdO
6	4874.01	Ce II	160	4883.69	Y II	3.5	4892.35	Ho I
3.0	4874.35	Ce I	22	4883.77	Sm I	3.0	4892.44	W I
3.0	4874.37	Nd I	3.5	4883.78	U	4	4892.50	Nb I
1.0	4874.37	Th I	30	4883.81	Nd I	2.0	4892.86	Ce I
4	4875.43	Pd I	7	4883.95	Ta I	4	4893.12	Zr I
46	4875.48	V I	75	4883.97	Sm I	4	4893.23	Nd I
8	4875.58	Tb II	2.5 h	4884.05	Eu I	8	4893.35	Sm II
5 d	4875.73	Nd I	1.2	4884.46	Pr I	8	4893.44	Y I
	4875.84	Nd II	4	4884.53	Dy I	5	4893.69	Dy I
4	4875.92	Dy I	4	4885.01	Nd I	8	4893.97	Ce II
6	4876.06	Sr I	36	4885.08	Ti I	1.6	4894.21	V I

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
8	4894.30	Gd II	7 d	4904.29	V I	5	4915.24	Ti I
3.5	4894.30	Sm II		4904.34	V I	1.4	4915.26	Hf I
3.0	4894.33	Tb	3.5	4904.41	Ni I	5	4915.32	Ce I
2.5 h	4894.63	Yb I	3.0	4904.42	Er II	2.0	4915.42	Pr I
6	4894.68	Eu I	5	4904.53	Nb I	4	4915.67	Ce I
3.5	4894.95	Th I	5	4904.59	Ta I	3.0	4915.83	Gd I
6	4895.32	Ru I	2.5 d	4904.88	Ce I	10	4915.90	Tb I
2.0	4895.58	Nb I	40	4904.88	Lu I	3.0	4916.18	W I
12	4895.60	Ru I	18	4904.97	Sm I	7	4916.42	Dy I
4	4896.14	Pr I	3.0	4905.02	Ru I	4	4916.60	Gd I
4	4896.44	Ho II	1.6	4905.08	Zr I	3.0	4917.06	Er I
24	4896.93	Nd I	2.0	4905.13	La I	2.0	4918.36	Ni I
3.0	4896.96	Er II	7	4906.11	Y I	44	4918.99	Sm I
3.0	4897.08	Ce I	8	4906.67	Sc I	5	4919.00	Fe I
1.6	4897.26	Mo I	10	4906.98	Pr I	19	4919.82	Th II
9	4898.16	Er II	6	4906.99	Ho II	12	4919.87	Ti I
3.0	4898.21	Ce I	10	4907.18	Eu I	2.5	4919.89	Ce I
2.5	4898.45	Th II	2.5	4907.26	Nd I	9	4920.11	Ta I
1.0	4898.80	Th II	2.0	4907.43	Mo I	8	4920.38	Sm II
4	4899.22	Os I	3.0	4907.73	Ta I	12	4920.50	Fe I
2.0	4899.23	Th I	2.5	4907.78	Nd I	2.0	4920.53	Th I
3.0	4899.25	Dy I	9	4907.89	Ru I	28	4920.68	Nd II
6	4899.25	Ru I	1.8	4908.12	Ce I	4	4920.78	Ce I
8	4899.29	U II	3.0	4909.00	Y I	80	4920.98	La II
1.2	4899.52	Co I	1.6	4909.19	Mo I	20	4921.07	Ru I
7	4899.90	Ce I	1.8	4909.74	Tm I	3.0	4921.14	Nd I
36	4899.91	Ti I	9	4909.76	Sc I	8	4921.27	Ta I
65	4899.92	La II	5	4910.05	Nd I	5	4921.62	Th II
40	4899.97	Ba II	7	4910.12	Gd I	17	4921.77	Ti I
24	4900.10	Er II	4	4910.35	U I	80	4921.79	La II
95	4900.12	Y II	65	4910.40	Sm I	10	4921.87	Y I
4	4900.62	V I	2.5	4910.74	W I	2.0	4921.92	Ce I
4	4900.73	Sm II	6	4910.95	Nb I	6	4922.21	Dy II
5	4900.79	Nb I	1.4	4911.39	Th I	22	4922.27	Cr I
4	4900.86	Eu I	12	4911.40	Eu I	3.0	4922.45	Nd I
2.5	4901.48	Pr II	1.6	4912.38	Yb I	5	4922.73	Ho I
10	4901.53	Nd I	3.0	4912.52	Th II	10	4922.84	Sc I
2.5	4901.68	Ce I	6	4912.60	Os I	1.4	4922.94	Th II
18	4901.84	Nd I	5	4912.63	Pr II	8	4923.15	Dy II
5	4901.87	La I	6	4913.16	U II	1.6	4923.47	Ta I
2.5	4901.90	Sm II	36	4913.25	Sm II	6	4923.58	Gd II
9	4902.03	Nd II	16	4913.41	Nd I	6	4923.83	Sm II
3.0	4902.32	W I	30	4913.62	Ti I	4	4923.83	Tm I
1.8	4902.90	Ba I	12	4914.03	Pr I	22	4923.90	Re I
1.6	4902.97	W I	1.2	4914.12	Th II	11	4924.04	Sm I
36	4903.05	Ru I	1.4	4914.30	Sm II	3.5	4924.09	Tb I
3.0	4903.24	Cr I	14	4914.37	Nd II	4	4924.26	Ce I
1.0	4903.32	Fe I	4	4914.94	Ce II	2.0	4924.42	Th II
6	4903.63	Er II	2.5	4914.96	Ta I	40	4924.53	Nd I
5	4903.81	Mo I	5	4915.02	Re I	18	4924.59	Pr I

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
3.5	4924.64	U II	2.0	4935.62	La II	3.0 c	4946.80	Ho I
1.4	4924.78	Mo I	5	4935.74	Sc I	7	4947.02	Nd II
2.0	4924.89	Ce	2.5	4935.81	Os I	3.0	4947.33	Ba I
2.0	4924.96	Ta I	1.2	4935.83	Ni I	5	4947.58	Th I
3.0	4925.04	Er I	12	4936.00	Pr I	5	4948.18	Ho II
2.0	4925.32	Pr I	8	4936.01	Gd I	2.0	4948.19	Ti I
5	4925.41	Ti I	6	4936.03	Sm II	4	4948.56	Gd I
5	4925.43	Er II	9	4936.33	Cr I	24	4948.63	Sm II
2.5	4925.63	Pr II	8	4936.33	Gd I	3.0	4948.67	Ce I
6	4925.65	V I	12	4936.42	Ta I	4	4948.76	Zr I
9	4926.00	Ta I	3.0	4936.77	Th I	3.5	4948.94	Hf I
3.0	4926.16	Ti I	1.4	4937.23	Yb II	4	4949.03	Nd
2.5	4926.19	Mo I	4	4937.63	Ta I	4	4949.55	Ce
2.5	4926.43	Mo I	3.0	4937.74	Ti I	28	4949.77	La I
3.5	4926.83	Tb I	5	4938.09	Ir I	6	4950.11	Gd I
2.0	4926.97	Er II	16	4938.10	Sm II	2.5	4950.17	U II
2.5	4927.36	Er II	9	4938.29	Ti I	4	4950.29	Nd I
1.4	4927.78	Th I	14	4938.43	Ru I	7	4950.62	Mo I
2.0	4928.09	Ce II	20	4938.61	Gd I	4	4950.64	Th II
14	4928.34	Ti I	3.5	4938.90	Pr I	3.0	4950.66	Y I
3.5	4928.44	U I	32	4939.01	Ho I	3.0	4950.67	Nd I
8	4928.86	Er I	6	4939.13	Ce I	34	4951.36	Pr I
5	4928.93	Tb I	3.0	4939.60	Ce	3.0	4951.58	Gd I
2.5	4928.98	Nb I	3.5	4939.64	Th I	20	4951.74	Er II
3.0	4929.56	Sm II	28	4939.74	Pr I	2.0	4951.92	Ce
8	4929.84	Gd I	14	4940.30	Pr I	5	4952.07	La II
1.4	4929.98	Th II	2.0	4940.34	Ce	16	4952.37	Sm II
2.5 d	4930.54	Ce I	2.0	4940.72	Tb II	6	4952.46	Nd I
	4930.72	Ce I	8	4941.33	Sc I	10	4952.47	Gd I
6	4930.69	Gd I	1.4	4941.52	Nb I	6	4953.03	Sm II
3.0	4930.72	Nd II	3.0	4941.58	Ti I	3.0	4953.09	W I
2.5	4930.87	Zr I	5	4941.66	Mo I	1.4	4953.13	Nb I
2.5	4930.93	Y I	16	4942.34	Lu I	6	4953.15	Gd I
4	4931.56	W I	6	4942.50	Cr I	3.5	4953.52	Eu I
7	4931.79	Tb I	2.5	4942.94	Os I	5	4953.60	Er II
2.5	4932.03	V I	3.0	4942.95	Nd II	2.0	4954.04	Ce I
2.5	4932.17	Pr I	1.4	4943.07	Th I	19	4954.06	Sc I
2.0	4933.06	U I	12	4943.45	Ce II	8	4954.57	Th II
5	4933.10	Mo I	2.5	4943.74	Pr II	3.0	4954.67	Er II
6	4933.64	Zr I	3.0	4943.84	Ce II	32	4954.78	Nd I
2.5	4933.66	U II	5	4943.90	Nd II	9	4954.81	Cr I
1.4	4933.85	Th I	14	4944.36	Er I	7	4955.26	Ru I
24	4934.07	Er I	10	4944.62	Ce II	3.5	4955.78	U I
2000	4934.09	Ba II	22	4944.83	Nd I	4 d	4955.95	Sm II
26	4934.12	Gd I	1.4	4945.47	Th I		4956.13	Sm II
10	4934.25	Sc I	2.0	4945.85	La I	2.0	4955.97	Ce I
1.6	4934.45	Hf II	13	4946.32	Sm I	2.5	4956.06	Pr I
11	4934.83	La II	8	4946.47	La II	7 c	4956.65	Pr II
6 c	4934.89	Ho I	1.4	4946.67	Th	5	4956.76	Re I
42	4935.51	Yb I	8	4946.72	Re I	3.5	4956.80	Gd I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
10	4957.18	Tm I	28 c	4967.21	Ho II	3.0	4975.12	Tm II
6	4957.29	Gd I	3.5	4967.33	U I	2.5	4975.14	Nb I
4	4957.31	Fe I	6 c	4967.78	Nb I	8	4975.25	Hf I
60	4957.36	Dy II	2.5	4967.89	Pr I	11	4975.35	Ti I
3.5	4957.37	W I	13	4967.94	Sr I	10	4975.50	Nd I
9	4957.54	Mo I	3.0	4968.40	Ce	10	4975.75	Pr I
13	4957.61	Fe I	2.0	4968.53	Ta I	3.0	4975.76	Eu I
6	4958.10	Nd II	2.0	4968.58	Gd II	3.0	4975.96	Th
1.4	4958.11	Ta I	6	4968.58	Ti I	24	4975.98	Sm I
2.0	4958.25	Ti I	2.0	4968.76	Th I	7	4976.20	Ru I
12	4958.79	Gd I, II	12	4968.90	Ru I	2.0	4976.20	Ta I
32	4959.13	Nd II	9	4969.16	Gd I	7	4976.40	Pr I
7 c	4959.42	Ho II	3.5	4969.69	Ta I	14	4976.41	Er I
3.0	4959.60	Dy I	4	4969.75	Nd I	1.6	4976.60	Th
3.5	4959.86	Ru I	6	4969.87	Er I	5	4977.23	Ce II
2.0	4959.93	Tb II	3.5	4970.06	Th I	6	4977.74	Ti I
3.5	4960.21	Eu I	26	4970.39	La II	5	4977.75	Rh I
5	4960.26	Pr I	2.5	4970.48	Ir I	2.5	4977.95	La I
1.6	4960.46	Th I	3.0	4970.67	Ce I	11	4978.20	Ti I
3.0	4960.90	Ce	3.0	4970.87	Tm II	3.5	4978.90	Tm I
4	4961.03	Ho II	2.5	4970.92	Pr I	13	4979.12	Mo I
16	4961.39	Nd II	4	4970.93	Nd II	3.5	4979.18	Rh I
3.5	4961.47	Gd I	3.0	4970.99	Tb II	3.5	4979.32	Os I
2.0	4961.49	Ce II	2.0	4971.26	Tm I	5	4979.85	W I
24	4961.94	Sm II	3.0	4971.42	Tb I	24	4979.97	Ho I
80	4962.26	Sr I	14	4971.48	Ce II	3.5	4980.16	Ni I
2.0	4962.28	Tb II	2.5	4971.93	Nb I	3.0	4980.16	Tb II
2.5	4962.30	Zr I	3.0	4971.94	Ce I	12	4980.35	Ru I
1.6	4962.37	Hf I	8 h	4971.99	Li I	17	4980.37	Sc I
3.5	4962.55	Eu I	1.4	4972.06	Ta I	3.0	4980.56	Tb I
2.0	4963.20	Th II	3.5	4972.10	U II	3.0	4980.68	Tm II
9	4963.33	Nd I	8	4972.16	Sm II	3.0	4980.88	Nd I
5	4963.71	Rh I	3.0	4972.18	Th II	1.6	4980.96	Th I
3.0	4963.72	Zr I	5	4972.24	Ce I	8	4981.28	Nd II
4	4964.12	Th II	1.4	4972.57	W I	6	4981.73	Sm II
1.6	4964.19	Mo I	5	4972.61	Gd I	550	4981.73	Ti I
2.5	4964.41	Mo I	4	4972.82	Nd	8	4982.13	Y II
6	4964.56	Sm II	3.0	4973.04	Tb I	20	4982.60	W I
5	4964.75	Ti I	7	4973.05	Ti I	4	4982.89	Nd I
3.0	4964.93	Cr I	5	4973.14	Nb I	4	4983.38	Sm II
2.5	4965.05	Gd II	1.4	4973.36	Mo I	4	4983.45	Ru I
2.0	4965.18	Ce I	2.5	4973.40	Nd I	9	4983.45	Sc I
4 c	4965.37	Nb I	3.0	4973.40	Th II	3.0	4983.54	W I
3.0	4965.88	Mn I	3.5	4973.58	Dy I	3.5	4984.13	Ni I
1.6	4966.12	V I	14	4973.66	Sc I	6 d	4984.51	Ce
3.0	4966.39	Ce I	5	4973.74	Sm II	2.0	4984.72	W I
4	4966.63	Er II	3.0	4974.10	Ce I	1.8	4985.30	Gd II
6 cw	4966.73	Ho II	2.5	4974.12	Ru I	2.0	4985.38	Th I
8	4966.91	Yb I	8	4974.30	Y I	5	4985.53	Dy I
7	4966.99	Er I	7	4974.92	Pr I	1.6	4985.56	Mo I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
8	4985.98	Re I	5	4998.13	Ce I	11	5009.65	Ti I
10	4986.42	Ce II	5	4998.37	Gd II	12	5009.78	Tm II
28	4986.83	La II	10	4998.55	Nd II	3.0	5010.59	Dy I
3.5	4986.90	U II	7	4999.07	Gd I	1.2	5010.81	Mo I
6	4986.94	W I	55	4999.47	La II	6	5010.82	Gd II
9	4987.15	Th II	380	4999.51	Ti I	12	5011.23	Ru I
10	4987.17	Nd II	1.0	4999.68	Hf II	2.0	5011.42	U I
4	4987.26	Ru I	2.0	4999.74	Ir I	2.5	5011.46	Zr I
7	4987.54	Ce I	7	4999.91	Mo I	6	5011.67	Nd II
1.8	4987.82	Zr I	1.6	4999.95	Th II	5	5011.74	Gd I
4	4988.69	Ce I	1.2 h	5000.34	Ni I	11	5011.77	Ce II
4 c	4988.96	Ho I	10	5000.38	Er II	1.2	5012.07	Fe I
9	4988.97	Nb I	8	5000.44	Nd II	4 c	5012.42	Ho I
2.0	4989.09	W I	4	5000.95	Nb I	1.4	5012.46	Ni I
14	4989.15	Ti I	22	5001.01	Ti I	4	5012.51	Ce I
8	4989.27	Pr II	2.5	5001.03	Tm I	6	5012.52	Ta I
1.6	4989.31	Th I	70	5001.14	Lu I	12	5013.17	Eu I
4	4989.32	Tm II	6	5001.22	Sm II	2.0	5013.27	Nb I
5	4989.44	Sm II	2.0	5001.57	Tm I	6	5013.28	Ho II
4	4989.46	Nd	4	5001.79	La I	22	5013.30	Ti I
28	4989.94	Nd II	1.2	5001.87	Fe I	5	5013.32	Cr I
4	4990.32	Er I	4	5002.10	Th I	6	5013.76	Ce I
6	4991.02	Ce II	2.5	5002.13	La II	300 d	5014.19	Ti I
440	4991.07	Ti I	3.0	5002.25	Nb I		5014.24	Ti I
11	4991.28	La II	5	5002.33	V I	2.0	5014.28	Ce
16	4991.92	Sc I	8	5002.45	Pr II	7	5014.55	Nd I
10	4992.02	Sm II	2.0	5002.74	Ir I	2.5	5014.56	Tm II
5	4992.36	Er II	5	5002.80	Ce	11	5014.60	Mo I
5	4992.40	Ce I	1.4	5002.80	W I	6	5014.62	V I
9	4992.74	Ru I	6	5003.86	Dy I	7	5014.95	Ru I
2.0	4993.78	Tm II	7	5004.26	Dy II	2.5	5014.98	Ir I
9	4993.85	Tb II	4	5004.58	Pr II	70	5015.04	Gd I
5	4993.88	La I	2.5	5004.78	Ce	20	5015.32	W I
1.4	4994.10	W I	2.0	5004.84	Tb I	2.0	5015.40	Nd
70	4994.13	Lu II	1.6	5004.91	Mn I	2.5	5015.54	Pr II
3.0	4994.30	Nb I	9	5005.44	Pb I	4	5015.90	Th II
14	4994.61	Ce I	1.0	5005.72	Fe I	55	5016.17	Ti I
1.4	4994.72	Tm II	3.0	5006.10	Tb II	4	5016.51	Ce I
8	4994.76	Zr I	2.5	5006.13	Fe I	6	5016.61	Sm II
10	4995.05	Ho I	30	5006.16	W I	1.6	5016.78	Mo I
3.0	4995.08	Ti I	2.5	5006.43	Ce	22	5017.26	Th II
1.4	4995.32	Mo I	7	5006.97	Y I	4	5017.59	Ni I
1.4	4995.32	W I	340	5007.21	Ti I	11	5017.75	Nb I
5	4995.84	Tb II	28	5007.25	Er I	2.0	5017.88	Tm II
7	4996.33	Zr I	1.6	5008.19	Th II	3.0	5017.99	Dy II
2.5	4996.82	La II	10	5008.22	U II	6	5018.20	Hf I
13	4997.10	Ti I	10	5008.97	Er II	9	5018.39	Sc I
2.0	4997.82	Th	22	5009.09	Ce I	11	5018.58	Pr I
3.5	4997.88	Nb I	1.4	5009.17	Ir I	3.5	5019.34	Th II
6	4997.95	Tb I	1.4	5009.52	Yb II	3.0	5019.36	Gd II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum
2.5 h	5019.51	La I
2.0	5019.51	Nb I
18	5019.76	Pr I
1.2	5019.85	Mo I
80	5020.03	Ti I
8	5020.14	Sc
2.5	5020.37	Gd I, II
1.4	5020.55	Th II
7	5021.44	Ce I
9	5021.51	Sc I
1.0	5021.75	Hf I
9	5022.12	Dy I
5	5022.16	Tb I
2.0	5022.67	Nd I
13	5022.87	Ce II
80	5022.87	Ti I
11	5022.91	Eu I
5	5023.13	Gd II
8	5023.50	Sm II
4	5023.99	Dy I
3.0	5024.24	Tb II
5	5024.28	Er II
3.0	5024.51	Dy I
3.0	5024.65	Tb I
55	5024.84	Ti I
2.5 h	5025.13	Ce
28	5025.58	Ti I
7	5026.18	Ru I
7	5026.36	Nb I
7	5026.53	Ho I
18	5026.97	Pr I
10	5027.15	Nd I
2	5027.29	Ce II
15	5027.38	U I
5	5027.85	Dy I
7	5027.85	Nd II
5	5028.16	Ru I
3.5	5028.17	Ho I
7	5028.30	Ce I
16	5028.32	Er I
20	5028.44	Sm II
11	5028.66	Th II
13	5028.90	Er II
5	5029.00	Mo I
10	5029.45	Nd I
7	5029.54	Eu I
1.4	5029.63	Th II
4	5029.76	Er II
2.0	5030.13	Nb I
2.5 h	5030.64	Ce
4	5030.78	Mo I
60	5031.02	Sc II
4	5031.18	Sm II
6	5031.29	Gd II
3.5	5031.56	Gd II
4	5031.74	Ce I
5	5031.83	Os I
4	5031.97	Ce II
3.0	5031.98	Pr
6	5032.74	Sc
6	5032.95	Ho
6	5032.98	Dy I
5	5033.12	Tb I
9	5033.38	Pr I
16	5033.52	Nd II
6	5033.55	Eu I
5	5033.81	Ce I
12	5034.24	Tm II
24	5034.42	Pr II
8	5035.37	Ni I
110	5035.91	Ti I
22	5035.94	Er I
80	5036.47	Ti I
5 h	5036.62	Ce I
16	5037.37	Ta I
6 c	5037.46	Pr II
7 c	5037.60	Ho I
7	5037.66	Ta I
13	5037.77	Ce II
70	5038.40	Ti I
1.4	5038.91	Mo I
10	5039.04	Nb I
7	5039.09	Gd I
4	5039.12	Os I
2.0	5039.24	Th I
7 d	5039.75	Ce I
	5039.93	Ce
3.0	5039.92	Nd I
110	5039.95	Ti I
3.5 h	5040.15	Th
6	5040.20	Nd I
2.5	5040.35	Ru I
5	5040.36	W I
4 d	5040.57	Th I
	5040.69	Th I
7	5040.62	Ti I
2.5	5040.74	Ru I
3.5	5040.82	Hf II
13	5040.86	Ce I
2.0 h	5041.00	Tm II
6 h	5041.62	Ca I
1.0	5041.76	Fe I
24	5042.05	Er II
5 w	5042.06	Tb II
5 d	5042.09	Ce I
14	5042.37	Ho I
20	5042.62	Dy I
2.5	5043.21	Ce
7	5043.32	Ta I
1.6	5043.51	Tm I
8	5043.59	Ti I
10	5043.83	Pr I
14	5043.86	Er I
19	5044.01	Ce II
1.4	5044.04	Pt I
3.5	5044.27	Ti I
55	5044.28	Sm I
1.4	5044.42	Ta I
4	5044.73	Ho I
4	5044.73	Th I
14	5044.89	Er I
1.6	5045.25	Th I
5.0	5045.41	Ti I
2.5	5045.41	Tm I
28	5045.53	Pr I
4	5045.99	Er II
1.4	5046.06	Ir I
1.6	5046.52	Mo I
20	5046.58	Zr I
11	5046.88	La I
1.6	5047.05	Th I
3.0	5047.25	Dy I
5	5047.31	Ru I
2.0	5047.42	U II
2.0	5047.43	Th II
6	5047.45	Hf I
6	5047.71	Mo I
2.0	5047.96	Nb I
2.0	5048.04	La II
2.5	5048.21	Ti I
1.8	5048.78	Gd II
7	5048.82	Ce I
1.2	5048.85	Ni I
6	5049.51	Sm I
20	5049.80	Th II
2.0	5049.82	Fe I
6 h	5050.17	Dy I
16	5050.57	La I
2.0	5050.80	Th I
6	5050.88	Gd II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
3.5	5050.99 Ce I		10	5062.11 Ti I		8	5070.26 Zr I	
5	5051.06 Nd I		2.0	5062.26 Tm I		8	5070.34 Er II	
3.5	5051.44 Ho II		2.0	5062.52 Mo I		12	5070.65 Dy I	
2.0	5051.63 V I		1.6	5062.64 Ru I		4	5071.02 Gd II	
1.0	5051.64 Fe I		2.5	5062.86 Gd II		75	5071.20 Sm I	
1.4	5051.90 Cr I		3.5	5062.92 La II		12	5071.48 Ti I	
2.0	5052.23 W I		3.5	5063.39 Pr I		4	5071.49 Ce I	
6	5052.67 Er I		12	5063.73 Nd II		11	5071.73 W I	
28	5052.76 Sm II		3.0	5063.77 U I		13	5071.77 Ce I	
10	5052.87 Ti I		5	5063.92 Ce I		7	5071.87 Nd I	
2.0	5053.22 Dy II		3.5	5064.07 Ti I		5	5072.19 Y I	
2.5	5053.27 Ce I		2.5	5064.12 V I		2.0	5072.43 Tm I	
4	5053.29 Dy I		4	5064.24 Sm II		3.0	5072.88 Os I	
75	5053.30 W I		28	5064.32 Sc I		3.5	5072.92 Cr I	
14	5053.40 Pr I		1.6	5064.61 Th I		7	5072.97 Ru I	
3.5	5053.53 Ce I		1.8	5064.64 Mo I		3.0	5072.99 Gd I	
2.0	5054.08 Ti I		130	5064.66 Ti I		5	5073.74 Gd I	
6	5054.17 Ce I		2.5 c	5064.84 Pr II		4	5073.87 Nd I	
6	5054.30 Tb I		29	5064.91 Zr I		6	5073.98 Zr I	
19	5054.61 W I		9	5065.22 Zr I		13	5074.33 Yb I	
3.5	5054.92 Ho II		6	5065.25 Nb I		7	5074.34 Ho I	
2.0	5054.98 Ba I		6	5065.79 Tb I		4	5074.52 Nd I	
3.0	5055.00 Mo I		2.0	5065.87 Tm I		8	5074.71 Ce I	
7	5055.36 Th II		10	5065.88 Ce I		3.5 b	5074.74 Hf HfO	
3.0	5055.42 Dy I		1.4	5065.91 Cr I		3.0	5074.77 Os I	
2.5	5055.53 W I		9	5065.99 Ti I		2.5	5074.79 Mn I	
4	5055.78 Ce I		6	5066.68 Tm I		26	5075.30 Ce II	
13	5056.46 La I		2.0	5066.79 Th I		2.0	5075.47 Th II	
10	5056.89 Nd I		4	5066.85 Nd		4 c	5075.68 Pr II	
34	5057.33 Ru I		3.0	5066.86 Sm II		28	5075.81 Sc I	
5 h	5057.60 Lu I		3.0	5067.06 Gd II		9	5076.32 Ru I	
9	5057.74 Sm II		4	5067.15 Ce		3.5	5076.37 Ta I	
2.0	5058.01 Mo I		1.0	5067.31 Yb II		2.0	5076.37 Tm I	
8	5058.01 Nb I		3.5	5067.71 Cr I		7	5076.47 Ce II	
4	5058.56 Re I		1.8	5067.80 Yb I		40	5076.59 Nd II	
6	5058.57 Th II		8	5067.87 Ta I		9	5076.69 Sm	
2.0 h	5058.70 Ta I		3.5	5067.90 La I		3.0	5076.75 Yb I	
3.0	5059.35 Nb I		5	5067.95 Eu I		8	5077.16 Nd II	
3.0	5059.48 Pt I		9	5067.97 Th I		2.0	5077.20 Tm I	
8	5059.85 Sm		3.5 h	5068.33 Ti I		2.0	5077.40 Nb I	
2.0	5059.86 Th I		1.0	5068.79 Fe I		14	5077.63 Er II	
12	5059.88 Mo I		9	5068.86 Sc II		15	5077.65 Dy I	
3.0	5060.04 Nd I		19	5069.15 W I		8	5077.82 Ce	
7	5060.39 Zr I		4	5069.15 Yb I		2.0	5077.82 U	
2.0	5060.43 Tm II		6	5069.35 Ti I		11	5078.25 Tb I	
4 c	5060.75 Ho I		24	5069.46 Sm II		38	5078.25 Zr I	
11	5060.90 Tm I		2.5 c	5070.01 Pr		1.8	5078.92 La I	
10	5060.93 Sm I		4	5070.19 Gd I		36	5078.96 Nb I	
2.5	5061.06 Gd II		5	5070.21 Y I		6	5079.09 Nd I	
3.5	5061.23 Th II		60	5070.23 Sc I		3.0	5079.09 Os I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
2.5	5079.38 La I		6	5090.63 Rh I		85	5103.45 Gd I	
2.0	5079.65 Hf II		7	5090.71 Ta I		8	5103.50 Os I	
50	5079.68 Ce II		2.0	5090.75 Th II		20	5104.48 Sm II	
8	5079.86 Sm I		4	5090.86 Ce		2.5	5105.14 V I	
2.0	5079.87 Mo I		2.5	5090.97 Mo I		16 d	5105.21 Nd II	
6	5080.02 Mo I		2.0	5091.34 Mo I			5105.35 Nd I	
2.5	5080.05 Tb II		5	5091.75 Ce I		40	5105.54 Cu I	
2.5 h	5080.21 La II		2.0	5092.16 Mo I		15	5106.23 La I	
7	5080.48 Ce I		9	5092.25 Gd II		6	5107.07 Ru I	
8	5080.51 Er		5	5092.46 Sc		2.0	5107.24 Th II	
8	5080.52 Ni I		5 h	5092.69 Eu I		3.0	5107.54 Tm I	
5	5081.11 Ni I		40	5092.80 Nd II		40	5107.59 Nd II	
2.5	5081.11 Tb I		9	5093.07 Ho I		2.5	5108.56 Tb I	
2.0	5081.26 Mo I		3.5	5093.38 Ce		1.2	5108.89 Co I	
240	5081.56 Sc I		15	5093.83 Ru I		17	5108.91 Gd II	
2.0	5081.80 Tb I		3.5 b	5093.88 Hf HfO		20	5109.06 Sc	
3.5	5081.89 Nd		1.8	5094.12 Th		2.0 c	5109.37 Ta II	
2.5	5082.25 Ta I		2.0 c	5094.41 Nb I		5	5109.44 Ti I	
5	5082.80 Gd I		3.5	5095.06 Th II		8	5109.71 Mo I	
0.8	5083.34 Fe I		3.0	5095.27 Ta I		1.6	5109.77 Ta I	
2.5	5083.54 Ce I		20	5095.30 Nb I		10	5110.31 Dy I	
140	5083.72 Sc I		2.5	5095.89 Mo I		3.5	5110.36 W I	
2.0 h	5084.08 Ni I		6	5096.06 Gd II		32	5110.38 Pr II	
2.5	5084.17 Ce I		6 h	5096.44 Eu I		2.0	5110.41 Fe I	
2.0	5084.45 Ce		7	5096.50 Re I		2.5	5110.75 Cr I	
2.5	5085.10 Tm I		7	5096.52 Nd II		50	5110.77 Pr II	
7	5085.26 Zr I		6	5096.65 Mo I		5	5110.81 Os I	
4	5085.34 Ti I		44	5096.73 Sc I		6	5110.81 Pd I	
1.2	5085.52 Rh		2.5 h	5097.24 Ce I		4	5110.86 Th II	
120	5085.55 Sc I		8	5097.52 Mo I		5	5111.60 Ce I	
280	5085.82 Cd I		2	5098.03 Mo I		1.0	5112.13 Hf I	
3.0	5085.86 U II		4	5098.05 Th		4	5112.27 Zr II	
85	5086.95 Sc I		12	5098.38 Gd II		14	5112.69 Ce I	
12	5087.07 Ti I		1.0	5098.71 Fe I		17	5112.86 Sc	
4	5087.08 Sm II		70	5099.23 Sc I		1.4	5113.13 Cr I	
16	5087.11 Pr I		1.4	5099.32 Ni I		18	5113.44 Ti I	
44	5087.14 Sc I		2.5	5099.40 Ce I		7	5113.99 Tm I	
5	5087.37 Ta I		2.0 h	5099.95 Ni I		11	5114.37 Eu I	
75	5087.42 Y II		8	5100.16 Nb I		3.0	5114.53 Nd I	
4	5087.65 Sm II		24	5100.22 Sm II		3.5	5114.55 Tm II	
2.0	5088.18 Y I			5100.39 Sm I		36	5114.56 La II	
1.8	5088.29 U I		1.8	5100.62 Th I		5	5114.97 Mo I	
8	5088.32 Sm I		5	5100.94 Gd II		2.5	5115.04 Th I	
3.0	5088.97 Sm II		2.5	5101.09 Tb I		10	5115.22 Ce I	
8	5089.12 Tb II		42	5101.12 Sc I		11	5115.24 Zr I	
4	5089.61 Ce		20	5102.39 Nd II		1.6	5115.40 Ni I	
2.5	5089.66 Tb I		36	5103.09 Sm II		7	5115.63 Ce I	
16 h	5089.84 Nd II		8	5103.11 Nd I		9	5115.84 Ta I	
30	5089.89 Sc I		1.8	5103.13 La I		36	5116.69 Sc	
10	5090.38 Dy II		2.0	5103.15 Ti I		19	5116.70 Sm II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
2.0	5116.97 Mo I		2.0	5126.20 Co I		5	5136.83 Nd	
8	5117.02 Pd I		4	5127.26 Ru I		1.6	5137.05 U	
70	5117.16 Sm I		15	5127.40 Er II		1.8	5137.08 Ni I	
17	5117.18 Ce II		4	5127.66 Nb I		5	5137.12 Ce I	
3.0	5117.25 Ta I		16	5127.81 Ho I		2.5	5137.76 Ce	
6	5117.25 U		2.5 h	5128.01 Ce		2.5	5138.02 Ce I	
3.5	5117.27 Pr I		1.2	5128.53 Hf II		3.5	5138.40 W I	
5	5117.94 Mn I		8	5128.53 V I		8	5138.42 V I	
2.0	5117.95 Ce II		11	5129.10 Eu I		1.8	5139.16 La I	
2.0 c	5118.02 Pr II		3	5129.15 Ti II		2.5	5139.26 Fe I	
3.5	5118.39 Tb I		6	5129.27 Ho II		3.5	5139.48 Fe I	
5	5118.87 Ce		1.4 h	5129.38 Ni I		1.8	5139.53 V I	
14	5119.11 Y II		36	5129.52 Pr II		24	5139.60 Dy II	
5 h	5119.49 Ce		18	5129.58 Ce I		4	5139.65 Cr I	
4.0	5119.61 Nd II		6	5130.08 Eu I		2.0	5139.76 Ce I	
7	5119.63 Er II		3.0	5130.11 W I		9	5139.80 Pr I	
16 h	5120.01 Dy I		6	5130.28 Gd II		1.6	5140.28 Tm II	
2.5	5120.18 Tb I		75	5130.60 Nd II		5	5140.50 Ce I	
8	5120.30 Nb I		1.6	5130.76 Rh I		3.5	5140.58 Nb I	
2.0	5120.32 Re I		3.5	5131.06 Th II		2.0	5140.77 Th I	
26	5120.42 Ti I		13	5131.52 Er I		8	5140.84 Gd II	
4	5120.42 Zr I		5 w	5131.69 Tb I		5 w	5141.08 Tb II	
1.6	5120.68 Tm I		3.5	5132.12 Ta I		7	5141.50 Gd I	
2.0	5120.69 Rh I		5	5132.21 Sm I		8	5141.62 Ta I	
7	5120.77 Ce I		19	5132.33 Nd II		15	5142.59 Ho	
3.5	5120.88 La I		2.0	5133.34 Nb I		7	5142.68 Gd I	
4.0	5121.30 Nd		7	5133.40 Zr I		13	5142.76 Ru I	
5	5121.35 Ce		24	5133.42 Pr I		1.8 h	5142.77 Ni I	
2.0	5121.61 Tb II		2.0	5133.45 Co I		12	5143.22 Ho	
4	5121.80 Nb I		14	5133.52 Eu I		8	5143.28 Th II	
48	5122.14 Sm I		2.5	5133.68 Fe I		9	5143.33 Nd II	
2.0	5122.23 Os I		8 b	5133.68 Sc ScO		7	5143.58 Er II	
7	5122.39 Ce I		15	5133.83 Er II		8	5143.69 Ta I	
3.0	5122.67 Ce I		5	5133.89 Ru I		2.0	5143.92 Th I	
2.0	5122.77 Co I		12	5134.05 Lu I		4	5144.09 Er II	
36	5122.99 La II		2.5	5134.23 Nd		1.2	5144.67 Cr I	
30	5123.21 Y II		6	5134.47 Ce I		2.0	5145.04 Th I	
1.4	5123.46 Cr I		10	5134.75 Nb I		2.0	5145.10 U II	
3.0	5123.65 Gd II		4	5135.01 Dy I		9	5145.38 Mo I	
2.5	5123.66 Ir I		240	5135.09 Lu I		34	5145.42 La I	
1.8	5123.73 Ru I		24	5135.13 Pr II		26	5145.47 Ti I	
38	5123.79 Nd II		12	5135.20 Y I		2.0	5145.54 Os I	
1.8	5123.83 Mo I		4 d	5135.32 Ce I		4	5145.77 W I	
3.5	5124.24 W I		1.6	5135.44 La I		3.0 h	5146.48 Ni I	
13	5124.56 Er I		6	5135.59 Gd I		4	5146.74 Co I	
6	5124.77 Eu I		5	5135.86 Sm I		0.8	5147.03 Yb II	
7	5124.86 Sm II		1.2	5135.99 Yb II		19	5147.24 Ru I	
7	5125.01 Ce I		7	5136.04 Gd I		7	5147.39 Mo I	
11	5125.56 Gd II		2.5	5136.47 Ta I		2.5	5147.46 Pr I	
1.6	5125.69 Co I		40	5136.55 Ru I		22	5147.48 Ti I	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
3.5	5147.54	Nb I	14	5156.74	La II	11	5166.06	Sm II
12	5147.55	Ce II	5	5156.76	Gd II	6	5166.23	Cr I
5	5147.58	Tb I	9	5157.07	Sm II	14	5166.70	Eu I
6	5147.62	Ta I		5157.23	Sm I	2.0	5166.79	Ta I
10	5148.22	Th II	1.2	5157.09	Rh I	2.0bl	5166.86	Ti TiO
5	5148.72	V I	14	5157.43	La II	75	5167.34	Mg I
2.0	5148.78	Ta I	2.0	5157.96	Hf I	3.5	5167.42	Hf I
1.0 l	5149.09	Na I	16	5158.00	Zr I	13	5167.49	Fe I
1.4	5149.38	Gd II	7	5158.48	Gd I	6	5167.76	Mo I
3.0	5149.40	Tm II	7	5158.60	Th I	6	5167.79	La I
18	5149.59	Ho	3.0	5158.67	Zr I	10 c	5167.88	Ho I
7	5149.65	Ce I	22	5158.69	La I	10	5167.92	Nd II
12	5149.74	Os I	3.5	5158.69	Rh I	2.5	5168.31	Pr I
3.0	5149.84	Gd II	3.0	5159.35	V I	7	5168.35	Sm I
2.5	5149.87	Pr I	30	5159.69	Ce I	1.2	5168.66	Ni I
11	5149.99	Ce I	6 h	5159.92	Ba I	2.5	5168.98	Os I
7	5150.41	Ce I	4	5160.00	Ru I	2.0	5169.25	Ce
1.8	5150.64	Nb I	18	5160.07	Eu I	7	5169.57	Sm II
2.0	5150.85	Ta I	12	5160.33	Nb I	14	5169.67	Dy II
4	5150.89	Mn I	7	5160.33	U II	3.5	5169.72	Ce I
8	5151.07	Ru I	6	5160.72	Th I	1.6	5169.94	V I
4	5151.62	Th II	4	5160.90	Gd II	11 bl	5170.11	Lu LuO
2.0	5151.87	Th II	6	5160.99	Zr I	3.0	5170.13	Tb I
2.5	5152.01	Os I	5	5161.00	Dy II	5	5170.18	Hf I
20	5152.20	Ti I	30	5161.48	Ce I	2.0	5170.23	Th II
9 c	5152.21	Pr II	2.5	5161.65	Re I	2.5	5170.61	Tb I
3.5	5152.63	Nb I	8	5161.71	Nd II	2.5	5170.91	Nd
4	5153.20	Ru I	18	5161.74	Pr II	70	5171.03	Ru I
20	5153.24	Cu I	6	5161.81	Ta I	5 b	5171.06	Sc ScO
6	5153.42	Ta I	4	5162.86	Sm	10 d	5171.08	Mo I
1.6	5153.53	W I	5	5163.19	Mo I		5171.25	Mo I
2.0 l	5153.64	Na I	6	5163.27	Ce II	6	5171.60	Fe I
7	5153.95	Ce	2.0	5163.46	Th I	1.6	5171.63	Ta I
2.5	5154.04	U	9	5163.62	La II	4	5171.69	Gd I
2.0	5154.05	Co I	5	5163.65	Ta I	220	5172.70	Mg I
8	5154.23	Sm II	7	5163.70	Gd I	34	5172.74	Sm I
4	5154.24	Th I	6	5163.83	Er II	14	5172.75	Er I
2.0	5154.39	Ce	17	5163.84	Pd I	2.5	5172.81	Dy II
50	5155.03	Sm II	5	5164.14	Dy II	2.0	5172.91	La II
38	5155.14	Ru I	5	5164.14	U I	14 h	5172.94	Mo I
24	5155.45	Zr I	2.5	5164.27	Tb I	100	5173.75	Ti I
5	5155.54	Rh I	12	5164.38	Nb I	6	5173.84	La II
3.0 h	5155.76	Ni I	8	5164.39	Ce I	55	5173.90	Pr II
80	5155.84	Gd I	5	5164.54	Gd II	10 h	5174.18	Mo I
8	5155.86	Sm I	3.0	5164.62	Sm	20	5174.54	Ce I
5	5156.01	Nd	19	5164.77	Er II	7	5175.19	Pr
8 h	5156.07	Sr I	4	5164.98	Th I	65	5175.42	Sm I
2.0	5156.34	Co I	19	5165.14	Nd II	4 c	5175.83	Pr II
7	5156.49	Pr II	6	5165.37	Dy I	5	5175.97	Rh I
26	5156.56	Ta I	7	5165.96	Zr I	2.5	5176.08	Co I

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18	5176.28	Gd II	3.0	5185.25	Tm I	4	5193.74	Eu I
5	5176.51	Tb I	9	5186.16	Tb I	3.5	5193.84	Th II
1.0	5176.56	Ni I	4	5186.34	Ti I	1.6 c	5193.99	Ta I
5	5176.77	V I	2.0	5186.84	Hf I	8 h	5194.04	Ti I
9	5176.79	Nd II	4	5186.92	Gd II	11	5194.41	Pr I
4	5176.96	Th I	5	5186.98	Nb I	6	5194.73	Sm I
1.0	5177.27	Rh I	2.5	5187.03	Zr I	2.0	5194.75	Ce I
44	5177.31	La I	2.0	5187.05	Nd I	8	5194.83	V I
4	5177.37	Pr I	6	5187.09	Sm I	3.0	5194.95	Fe I
3.0	5177.43	Cr I	5	5187.24	Gd II	14	5195.02	Ru I
2.0	5177.73	Ce I	40	5187.45	Ce II	13	5195.11	Pr II
1.6	5177.95	Ir I	1.2	5187.46	Th I	2.0	5195.23	Ho I
10 h	5178.01	Sm II	2.0	5187.75	Hf II	18	5195.31	Pr II
3.5	5178.10	Gd II	6	5187.85	Ho I	4	5195.36	V I
3.0	5178.69	Ce I	5	5187.88	Gd I	7	5195.48	Pr I
2.0	5178.75	Nd I	20	5188.22	La II	6	5195.60	Nd I
4	5178.84	Gd II	2.0	5188.24	Pr	2.0	5195.63	W I
4 c	5178.89	Re I	5	5188.48	Dy II	4 h	5195.82	Th I
1.4	5178.99	Zr I	5	5188.48	Tb I	7	5195.84	Nb I
1.8	5179.12	La I	2.0	5188.53	Ce	3.5	5196.09	Yb I
3.0	5179.48	Er II	8	5188.65	Ce I	8	5196.43	Y II
3.5	5179.78	Nd II	8	5188.70	Ti II	7	5196.44	Cr I
3.5	5179.92	Gd II	10 h	5188.85	Ca I	4	5196.59	Mn I
5	5179.97	Tb I	18	5188.90	Er II	15	5196.61	Lu I
11	5180.31	Nb I	1.6	5188.93	Ta I	12	5197.66	Dy II
8	5180.89	Ce I	9	5189.20	Nb I	38	5197.77	Gd I
3.0 c	5180.98	Ta I	4	5189.25	Ce	6	5198.07	Nd I
14	5181.17	Nd II	1.8	5189.68	Th II	4	5198.81	Th
2.0	5181.74	Re I	10	5190.11	Ho	5	5198.86	Tb I
2.5	5181.75	Ce I	4	5190.88	Th II	8	5199.16	Th I
15	5181.86	Hf I	5	5191.08	Gd II	4	5199.21	Gd II
5	5181.94	Ce I	18	5191.34	Pr II	13	5199.85	Eu I
14 c	5182.11	Ho I	2.5	5191.44	Mo I	6	5199.87	Ru I
3.0	5182.53	Th II	55	5191.45	Nd II	4	5200.12	Ce I
13	5182.60	Nd II	4	5191.47	Fe I	36	5200.12	Nd II
1.4	5182.68	Tm I	8	5191.60	Zr II	7	5200.17	Mo I
4	5183.20	Ce I	30	5191.68	Ce II	3.0	5200.19	Cr I
65	5183.42	La II	6	5192.00	Cr I	65	5200.41	Y II
400	5183.62	Mg I	1.4	5192.01	V I	6	5200.42	Ce I
8	5183.70	Zr I	6	5192.36	Fe I	2.5	5200.55	Gd II
4	5183.85	Pr II	70	5192.62	Nd II	34	5200.59	Sm I
7	5183.92	La I	4	5192.72	W I	3.0	5200.74	Mo I
3.0	5183.97	W I	36	5192.89	Dy II	7	5200.96	Eu I
3.0	5183.99	Th II	120	5192.98	Ti I	6	5201.10	Ti I
1.2	5184.18	Yb II	8	5192.99	V I	8	5201.15	Zr I
3.0	5184.19	Rh I	8	5193.08	Nb I	6	5201.39	Ce I
6	5184.59	Cr I	8	5193.14	Rh I	4	5201.45	Sm I
5	5184.59	Tb I	1.0	5193.49	Cr I	3.5	5201.47	Pb I
5	5184.59	U II	3.5	5193.52	Os I	3.5	5202.12	Ru I
10	5185.14	Dy I	1.6	5193.62	V I	2.5	5202.34	Fe I

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10 d	5202.46	Ce I	44	5210.52	Sc I	7	5221.57	Nd II
	5202.59	Ce I	3.5	5211.04	Ce I	2.5	5221.75	Cr I
24	5202.63	Os I	4	5211.23	Th I	5	5221.92	Ce I
8	5202.73	Sm II	5	5211.28	Sc	4	5221.99	Tb I
3.5 w	5202.77	Tb I	1.4	5211.52	Rh I	14	5222.20	Sr I
3.0	5203.22	Nb I	5	5211.59	Yb I	1.6	5222.66	Rh I
3.0	5203.23	Os I	55	5211.86	La I	9	5222.69	Ti I
4	5203.26	W I	3.0	5211.86	Mo I	5	5222.95	Ce I
6	5203.28	Ce I	20	5211.92	Ce I	28	5223.49	Ce I
13	5204.15	La II	6	5212.29	Ti I	20	5223.49	Eu I
6	5204.27	Ce I	34	5212.37	Nd II	5	5223.55	Ru I
4	5204.32	U	6	5212.71	Co I	8	5223.64	Ti I
7	5204.38	Nd I	1.6	5212.73	Rh I	24	5224.32	Ti I
5	5204.51	W I	9	5212.74	Ta I	9	5224.56	Ti I
440	5204.52	Cr I	4	5212.79	W I	70	5224.67	W I
1.0	5204.52	Tm II	7	5212.91	Er II	7	5224.93	Zr I
4	5204.55	Tb I	17	5213.23	Nd I	7	5224.94	Cr I
4	5204.73	Ce I	2.0	5213.35	Th I	18	5224.95	Ti I
1.6	5205.13	Nb I	6	5213.38	Tm I	14	5225.05	Nd II
3.5	5205.14	Ce I	3.5	5213.43	Ru I	20	5225.11	Sr I
4	5205.52	Ce II	1.6	5214.13	Cr I	2.0	5225.12	U II
4	5205.69	Dy I	4	5214.28	Tb I	3	5225.16	Nb I
100	5205.72	Y II	1.4	5214.79	Rh I	2.5	5225.77	V I
2.0	5205.77	Th II	50	5215.10	Eu I	2.5	5226.21	La II
700	5206.04	Cr I	3.5	5215.13	Er II	4	5226.36	Ce II
11	5206.08	Ti I	10	5215.65	Nd II	6	5226.56	Ti II
5	5206.19	W I	2.5	5216.28	Fe I	3.0	5226.88	Fe I
1.6	5206.26	Ta I	4	5216.38	Ce I	1.0	5226.89	Cr I
8	5206.44	Eu I	8	5216.58	Th II	12	5227.19	Fe I
8	5206.47	Lu I	3.0	5216.59	V I	3.5	5227.66	Pt I
5	5206.49	Th II	4	5216.76	Pr II	10	5228.01	Pr I
	5206.65	Th II	8	5217.48	Gd I	12	5228.12	Tb I
17	5206.52	Er I	100	5218.20	Cu I	1.6	5228.24	Tm II
32	5206.56	Pr II	3.5	5218.24	Er II	14	5228.43	Nd II
1.4	5206.61	V I	8	5218.40	Sm I	8 h	5228.80	Sm I
1.4	5206.95	Rh	9 d	5218.45	Ta I	20	5229.27	Sr I
7	5207.87	Ti I		5218.66	Ta I	5	5229.32	Er II
13	5207.90	Pr II	4	5218.52	Th II	19	5229.75	Ce I
4	5207.97	Tb I	32	5219.05	Pr II	5	5230.14	Ce I
900	5208.44	Cr I	4 c	5219.10	Nb I	6	5230.22	Co I
3.5	5208.74	Ce	3.0	5219.10	Th I	2.0 c	5230.27	Pr
3.0	5208.90	Ce I	26	5219.40	Gd I	1.6	5230.62	Rh I
100	5209.07	Ag I	5	5219.40	Mo I	3.0	5230.80	Ta I
7	5209.30	Zr I	32	5219.67	Sc I	6	5230.84	Ce I
2.0	5209.34	Tb II	14	5219.71	Ti I	4	5231.06	Mo I
8	5209.92	Sm I	16	5220.07	Cu I	9	5231.16	Th I
3.0	5210.34	Ce II	50	5220.11	Pr II	2.0	5232.02	Th
130	5210.39	Ti I	7	5220.30	Gd II	1.6	5232.36	Mo I
1.6	5210.44	Mo I	4	5221.12	Sm I	7	5232.81	Nb I
5	5210.49	Gd II	5	5221.54	Ho	15	5232.91	Ce II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
11	5232.94 Fe I		7	5242.99 W I		2.0	5253.40 Ce	
7	5233.21 Th II		7	5243.08 Ce I		1.6	5253.45 Th I	
3.0	5233.54 W I		2.5	5243.40 Cr I		26	5253.46 La I	
2.5	5233.75 V I		2.5	5243.47 Zr I		3.0	5253.80 Sm I	
2.0	5233.79 Ce I		1.8	5243.69 Pr		4	5253.93 Nb I	
12	5233.93 Gd I		7	5243.99 Hf I		3.0	5254.54 W I	
6	5234.01 Ce II		6	5244.11 Yb I		1.0	5254.65 Co I	
8	5234.07 V I		2.0	5244.38 Gd I		8	5254.75 Gd I	
6 h	5234.18 Sm II		4 c	5244.47 Ho I		6	5254.84 Ce I	
50	5234.20 Nd II		10	5244.51 Ce I		5	5254.92 Cr I	
6	5234.26 Mo I		1.4	5244.78 Ta I		5	5255.13 Cr I	
40	5234.27 La I		2.0	5245.28 Ce I		7	5255.32 Mn I	
3.5	5234.31 Re I		6	5245.51 Mo I		4	5255.42 W I	
6	5234.86 Pd I		28	5245.92 Ce I		40	5255.51 Nd II	
4	5235.11 Tb I		2.0	5246.15 Ti I		13	5255.80 Gd I	
5	5235.21 Co I		5	5246.57 Ti I		4	5255.82 Os I	
2.5	5235.39 Ta I		6	5246.87 Gd I		7	5255.83 Ti I	
2.5	5235.77 Ce II		6	5246.93 Dy II		3.0	5255.95 Ce	
5	5237.05 Ce II		3.5	5247.10 Hf II		16	5255.95 Er II	
4	5237.16 Rh I		7	5247.31 Ti I		2.5	5256.47 Er II	
4 c	5237.43 Nb I		1.6	5247.35 U II		48	5256.90 Sr I	
2.5	5237.53 Ta II		24	5247.56 Cr I		3.0	5257.02 Er II	
4 h	5237.58 Sm I		8	5247.65 Th II		4	5257.04 U II	
0.8	5237.80 Rh		4	5247.75 U II		3.0	5257.07 Ru I	
3.5	5237.90 Th II		6	5247.93 Co I		2.5	5257.35 Nd	
28 h	5238.20 Mo I		2.0	5248.12 Dy II		2.5	5257.51 Yb II	
6	5238.49 Ce I		8	5248.71 Tb I		2.0	5257.62 Co I	
28	5238.55 Sr I		5	5248.86 Re I		2.5	5257.85 La I	
11	5238.58 Ti I		2.0	5249.18 Ce I		32	5258.33 Sc I	
1.6	5238.61 U		80	5249.59 Nd II		3.0	5258.36 Th I	
2.0	5238.91 Ce		3.5	5249.62 Ce I		2.0	5258.39 Dy II	
1.8	5238.92 Ir I		2.0	5249.84 Pr I		3.0	5258.40 Ce II	
1.6	5238.97 Cr I		1.2	5250.00 Co I		9	5259.04 Mo I	
8	5239.24 Eu I		1.8	5250.46 Os		6	5259.36 W I	
2.5	5239.55 La I		22	5250.82 Nd II		8	5259.39 La II	
28	5239.79 Nd II		2.0	5250.95 Ti I		60	5259.74 Pr II	
40	5239.82 Sc II		4	5251.03 Ce		9	5259.91 Dy I	
1.8	5239.83 Ce II		30	5251.18 Gd I		3.0	5259.93 Ce I	
2.0	5240.09 Ce		7 d	5251.62 Nb I		5	5259.99 Ti I	
3.5	5240.18 Th II			5251.81 Nb I		1.0	5260.17 Mo I	
1.4	5240.20 V I		4	5251.67 Ru I		1.6	5260.44 Hf II	
1.4	5240.39 Nb I		6 c	5251.74 Pr II		16	5260.57 Dy I	
2.0	5240.52 Yb II		7	5251.82 Ho I		2.0	5260.81 Gd I	
12	5240.81 Y I		36	5251.92 Sm I		1.0	5260.93 Tm II	
2.0	5240.83 La I		8	5251.98 Ce		1.2	5260.98 V I	
8	5240.87 V I		10	5252.11 Ti I		4	5261.14 Mo I	
14 h	5240.88 Mo I		11	5252.14 Gd I, II		11	5261.70 Ca I	
3.0	5242.38 Ru I		8	5252.62 Ce II		9	5261.71 Ce I	
2.0 c	5242.67 Pr		5	5252.77 Sm II		1.6	5261.75 Cr I	
7 h	5242.81 Mo I		3.5	5253.03 Nb I		8 w	5262.11 Tb II	

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
13	5262.25	Ca I	55	5271.40	Sm I	2.0	5279.56	Yb II
1.2	5263.21	W I	13	5271.53	Nb I	4	5279.65	Mo I
7 bl	5263.3	Dy DyO	2.0	5271.79	Gd I	6	5279.71	Dy II
5	5263.50	Ti I	2.0	5271.80	Mo I	1.4	5279.82	Ta I
3.0	5263.81	Gd I	13	5271.88	Ce I	6	5280.05	Zr I
16	5263.88	Pr II	26	5271.96	Eu I	1.0	5280.08	Th II
44	5264.15	Cr I	3.0	5272.00	Nd	0.9 h	5280.12	Rh I
9	5264.21	Ce I	1.4	5272.00	U I	1.6	5280.29	Cr I
4	5264.22	Nd I	3.0	5272.01	Cr I	6	5280.38	U I
11	5264.24	Ca I	2.0 w	5272.07	Tb II	5 h	5280.65	Co I
4.0	5264.75	Er II	6	5272.25	Dy II	3.0	5280.82	Ru I
1.4	5264.92	Tb	3.0	5272.37	Gd I	13	5280.86	Mo I
2.0	5264.95	Hf II	7	5272.48	Eu I	1.4	5281.02	Ta I
5	5265.15	Os I	1.2	5272.48	Nb I	8	5281.05	Tb I
2.5	5265.16	Cr I	1.4	5272.72	Pr	1.8	5281.38	Ce I
28	5265.56	Ca I	3.5	5272.82	Sm II	2.0	5281.80	Fe I
3.5	5265.67	Sm I	9	5272.90	Er I	7	5282.07	Dy I
14	5265.71	Ce II	5	5272.91	Gd I	4	5282.39	Ti I
15	5265.72	Cr I	65	5273.43	Nd II	5	5282.48	Gd I
3.0 h	5265.74	Nd	2.5	5273.44	Cr I	10	5282.82	Eu I
1.0	5265.82	Co I	36	5274.24	Ce II	34	5282.91	Sm I
14	5265.98	Ti I	2.5	5275.02	Ta I	26	5283.08	Gd I
3.0	5266.30	Co I	2.5	5275.03	Tb I	13	5283.45	Ti I
13	5266.40	Eu I	3.5	5275.04	Hf I	1.0	5283.49	Co I
3.0	5266.47	Ru I	8 h	5275.17	Cr I	4	5283.63	Fe I
5	5266.49	Co I	6	5275.31	Dy II	1.2	5283.84	Mo I
5	5266.58	Fe I	6	5275.48	Ho I	1.8	5283.89	Os I
2.5 h	5266.64	Nd I	4	5275.55	W I	10	5284.08	Ru I
1.0	5266.70	Th I	160 cw	5275.56	Re I	3.5	5284.39	Ti I
3.0	5266.83	Ru I	3.0 h	5275.69	Cr I	4	5284.97	Sc I
2.0 h	5267.03	Ba I	3.5	5275.78	Ce II	3.5	5284.99	Dy II
8	5267.13	Dy I	6 h	5276.03	Cr I	2.5	5285.26	Nb I
1.8	5267.34	Tm II	2.0 h	5276.19	Co I	8	5285.63	Pr I
2.0	5268.01	Gd I	6 c	5276.20	Nb I	24	5285.76	Sc I
3.0	5268.52	Co I	3.0	5276.26	Ce	1.4	5286.09	Hf I
6	5268.78	Gd I	2.0	5276.28	Mo I	6	5286.68	Nd I
1.2	5268.95	Mo I	4	5276.42	La I	3.5	5286.84	Ce I
1.2	5269.27	Rh I	16	5276.88	Nd II	4	5287.13	Nd
13	5269.48	Nd	9 h	5277.08	Yb I	0.8	5287.19	Cr I
5	5269.52	Ce I	2.0 c	5277.32	Pr	3.5	5287.25	Eu I
22	5269.54	Fe I	10	5277.41	Zr I	1.4	5287.30	Tb
10	5269.78	Nd II	6	5277.50	Th II	0.8	5287.57	Co I
2.5	5269.92	Nb I	1.8	5277.54	Ce I	0.9	5287.81	Co I
6	5270.09	Nd I	6	5277.70	Er I	1.6	5288.40	U II
48	5270.28	Ca I	2.0	5278.18	U II	2.5	5288.81	Ti
8	5270.36	Fe I	10	5278.24	Re I	4	5289.25	Eu I
6	5270.69	Nd	1.6	5278.43	Ce	4	5289.35	Pr I
130	5270.95	Re I	2.0	5279.13	La II	4	5289.82	Y II
3.5	5271.06	Ce I	3.0	5279.33	Er II	3.5 h	5289.94	Sm I
28	5271.19	La I	1.4 c	5279.43	Nb I	11	5290.84	La II

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5	5290.94	Ce I	10	5301.25	Ho I	3.0	5309.46	Tb I
3.0	5291.15	Tm I	3.0	5301.40	Th II	3.0	5309.50	Sm I
3.0	5291.16	Ru I	2.0	5301.59	Dy I	3.0	5309.68	Hf I
8	5291.26	Eu I	26	5301.67	Gd I	1.4	5309.93	Ce
1.8	5291.31	Ce	4	5301.94	Sc I	5	5310.01	Nd
12	5291.67	Nd I	5	5301.97	Zr I	1.8	5310.04	U
3.5	5292.08	Mo I	28	5301.98	La II	0.5	5310.20	Co I
30 c	5292.10	Pr II	1.6	5302.19	Ce	3.5	5310.25	Th II
1.2	5292.14	Rh I	18	5302.28	Nd II	8	5311.12	Pr II
1.8	5292.40	Ce	5	5302.30	Er II	9	5311.40	Zr I
4 h	5292.52	Cu I	2.5	5302.31	Fe I	24	5311.46	Nd II
30	5292.63	Pr II	1.0	5302.35	Mo I	3.5	5311.60	Hf II
75	5293.17	Nd II	1.2	5302.58	Os I	4	5311.84	Gd I
2.0	5293.46	Mo I	3.0	5302.61	Nd I	3.5	5311.88	U II
4	5293.68	Eu I	11	5302.62	La II	3.0	5312.00	Th I
7	5294.07	Ce I	2.5	5302.70	Tm I	5	5312.23	Sm II
3.0	5294.32	Tm I	20	5302.76	Gd I	6 cw	5312.33	Pr II
8	5294.64	Eu I	1.0	5303.04	Th II	3.0	5312.53	Th I
5	5294.65	Sm I	1.6	5303.15	Ce	2.0	5312.57	Pd I
5	5294.82	Zr I	7	5303.21	Nd II	2.0 h	5312.66	Co I
1.8	5294.87	Ce	5	5303.23	Sm I	1.4	5312.73	U II
8	5294.87	Hf I	3.5	5303.35	Ce I	2.0	5312.88	Cr I
7	5295.01	Ta I	14	5303.55	La II	2.5	5313.39	Pr
3.5	5295.47	Mo I	6	5303.85	Eu I	3.0	5313.76	Sm I
13	5295.63	Pd I	3.5	5304.02	La I	3.5	5313.89	Mo I
1.8	5295.65	Os I	1.4	5304.21	Cr I	3.5	5313.93	Ce I
6	5295.79	Ti I	3.5	5304.40	Lu I	3.5	5314.40	Ce I
1.6	5296.34	Nb I	1.0	5304.63	Th II	4	5314.55	Nd
14	5296.60	Ce I	7	5304.72	Tb I	1.2	5314.79	Rh I
28	5296.69	Cr I	6	5304.86	Ru I	2.5	5314.90	Ce I
10	5296.79	Zr I	3.0	5305.56	Re I	2.5	5314.99	Ce I
11	5297.26	Ti I	1.4	5305.57	Th II	2.0	5315.04	Mo I
6 h	5297.36	Cr I	4	5305.88	Tm II	1.6	5315.27	U I
2.5	5297.74	Th I	1.2	5306.26	Mo I	1.0	5315.33	Ru I
5	5297.83	Dy II	12	5306.47	Nd II	2.5	5315.55	Nb I
3.0	5298.06	Hf II	5	5306.70	Gd I	2.0 h	5315.79	Gd II
20	5298.11	Pr II	48	5307.12	Tm I	6	5316.60	Nd II
55	5298.27	Cr I	26	5307.30	Gd I	1.4	5316.61	Pr I
3.5	5298.29	Ce I	2.5	5307.46	Th II	1.2	5316.78	Co I
6	5298.44	Ti I	1.8	5307.53	La I	3.0	5316.80	Gd II
3.0	5298.58	Gd I	2.0	5307.82	Hf I	0.8	5317.01	Nb I
3.5	5298.78	Os I	3.0	5308.19	Tb I	2.0	5317.28	Re I
2.5	5298.88	Nd I	3.0	5308.28	Nd I	2.0	5317.58	Ce I
1.8	5299.10	Ce	2.5	5308.32	Ce I	2.5	5318.35	Sc II
2.5	5300.21	Tm I	3.0	5308.42	Nd II	12	5318.60	Nb I
3.0	5300.58	Nd I	3.5	5308.54	U I	3.0 c	5318.67	Ta I
7	5300.75	Cr I	7	5308.55	Ce I	2.0	5318.78	Cr I
1.0	5300.95	Yb II	2.0	5308.96	Pr II	2.5	5318.87	W I
4	5301.02	Pt I	5	5309.02	Dy II	5	5319.11	Nd
3.0	5301.06	Co I	20	5309.27	Ru I	11	5319.23	Tb I

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4	5319.24	Ho I	6 h	5329.17	Cr I	3.0	5337.43	Dy II
1.8	5319.38	U	3.5	5329.26	U I	5	5337.53	Gd I
2.5	5319.49	Nb I	2.0	5329.38	Th II	1.8	5337.70	Ce
4	5319.65	Ho I	4	5329.50	Ce I	7 w	5337.90	Tb I
55	5319.82	Nd II	1.4 h	5329.72	Cr I	5	5338.01	Nd
1.2	5319.89	Mo I	3.5 h	5329.74	Rh I	1.0	5338.43	Zr I
1.2	5320.16	La I	3.5 h	5329.82	Sr I	3.5 d	5338.59	Tb I
26	5320.60	Sm I	2.0	5329.88	Nd I	2.5	5338.92	Tm I
3.0	5320.78	Y II	9	5330.11	Ho I		5339.03	Tm I
3.0	5320.79	Nd I	20	5330.58	Ce II	11	5339.41	Sc I
8	5321.09	Pr II	1.8	5330.84	Zr I	1.4	5339.94	Fe I
4	5321.25	Gd I	3.5	5331.04	Tb I	8	5340.31	Dy I
2.0	5321.26	Zr I	1.2 h	5331.08	Rh I	1.2	5340.44	Cr I
3.5	5321.28	Re I	2.5	5331.47	Co I	8	5340.67	La II
12	5321.50	Gd I	6	5331.48	Pr II	2.5 d	5340.70	Ce
1.4	5321.60	U II	8	5331.77	Sc I	1.0	5340.74	Ir I
0.4	5321.72	Co I	2.0	5331.90	Re I	2.5	5340.80	Nb I
26	5321.78	Gd I	4	5331.92	Gd I	1.8	5341.03	Fe I
3.5	5321.81	Pr II	2.5	5332.09	Sm I	14	5341.05	Sc I
2.5 h	5321.82	Sm I	3.0	5332.24	Ce	11	5341.05	Ta I
1.6	5322.11	Tb II	3.0	5332.43	Nd I	13	5341.06	Mn I
3.0	5322.37	Gd I	1.2	5332.58	Tb I	3.0	5341.17	Gd I
4	5322.69	Gd I	0.9	5332.67	Co I	15	5341.29	Sm I
38	5322.78	Pr II	2.0	5332.76	Re I	1.4 h	5341.33	Co I
1.2	5323.00	Tm II	3.0	5332.93	Ru I	1.6	5341.50	Ti I
4	5323.32	Ce	6	5333.02	Er I	1.4cw	5341.6	Pr
2.5	5323.57	La I	16	5333.30	Gd I	3.0	5341.81	Gd I
1.6	5323.92	Tb II	3.0	5333.36	Er II	2.0	5342.25	Ta I
7	5324.18	Fe I	0.9	5333.65	Co I	1.8	5342.55	Pr
0.8	5324.26	Hf II	1.8	5333.83	Ce	6	5342.71	Co I
1.2	5324.47	Mo I	2.0	5333.85	Re I	11	5342.96	Sc I
4	5324.59	Nd I	3.0	5334.20	Er II	28	5343.00	Gd I
6	5324.70	Dy II	1.6	5334.23	Sc II	3.0	5343.39	Co I
3.0hd	5324.99	Sm I	3.0	5334.33	Nd I	1.2	5343.58	Nb I
5	5325.14	Th II	1.8	5334.67	Ce	5	5343.58	Th I
1.8 h	5325.28	Co I	3.5 h	5334.70	Ru I	1.8	5343.65	Nd I
0.6	5325.95	Co I	1.0	5334.79	Mo I	5	5343.86	Pr II
4	5326.98	Th I	0.9	5334.84	Co I	2.5	5343.93	Er II
2.0	5327.06	Mo I	3.5	5334.87	Nb I	22	5344.17	Nb I
10	5327.32	Gd I	10	5335.15	Yb II	3.5	5344.50	Er II
5	5327.46	Re I	8	5335.71	Ce I	0.8	5344.76	Cr I
3.0	5327.71	U	8	5335.93	Ru I	1.8	5345.10	Ce
14	5328.05	Ce I	2.5	5336.13	Ta I	1.6	5345.10	Pd I
18	5328.05	Fe I	7	5336.18	Ce I	8	5345.13	Gd I
6	5328.30	Gd I	1.6	5336.23	Os I	2.5	5345.31	Th II
28 h	5328.34	Cr I	10	5336.55	Nd II	1.8 d	5345.67	Yb II
6	5328.38	Ta I	1.2	5336.81	Nb I		5345.85	Yb II
2.5	5328.53	Fe I	2.5	5336.81	Ti II	7	5345.68	Gd I
1.6	5329.05	Tb I	1.0	5337.20	Mo I	9	5345.71	Nd II
3.0	5329.11	Nd	2.5	5337.37	W I	65	5345.81	Cr I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
1.0	5346.03	Os I	6	5352.05	Co I	5	5361.17	Nd II
1.6	5346.14	Tb I	4	5352.13	Dy I	32	5361.47	Nd II
0.6	5346.30	Hf II	4	5352.20	Ce	8	5361.61	Eu I
6	5346.50	Tm II	1.2	5352.25	Os I	5	5361.66	Gd I
2.5	5346.53	Ce	1.2	5352.35	Mo I	10	5361.77	Ru I
1.2	5347.04	Th II	18	5352.40	Pr II	0.8	5362.01	Nb I
3.5	5347.22	Yb II	2.5	5352.84	Eu I	1.6	5362.40	U
0.8	5347.49	Co I	9	5352.96	Yb II	6	5362.56	Zr I
3.5	5347.81	Ce I	22	5353.26	Gd I	1.6	5362.68	Ce
2.5	5347.93	Tb	2.0	5353.28	Nb I	2.5 h	5362.77	Co I
10	5348.04	Er I	3.0	5353.41	V I	8	5363.33	Ce I
4	5348.08	Sm I	3.0	5353.48	Co I	1.0	5363.35	Zr I
32	5348.32	Cr I	48	5353.53	Ce II	1.0	5363.62	Tb I
19	5348.67	Gd I	11	5354.40	Rh I	1.8	5363.66	Yb I
6	5348.74	Sm I	2.0	5354.46	W I	1.6	5363.82	U II
4	5348.95	W I	5	5354.68	Ta I	7 hl	5364.28	Mo I
0.8	5349.09	Co I	7	5354.73	Hf I	3.0	5364.32	Ir I
4	5349.09	Ta I	5	5354.88	Mo I	3.0	5364.39	Sm II
7	5349.12	Lu I	17	5354.88	Tb I	1.2	5364.88	Fe I
5	5349.14	Sm I	6	5355.10	Eu I	4	5365.12	Nd II
1.6	5349.20	Ce	6	5355.18	Ce I	9	5365.38	Gd I
2.5	5349.26	Nd I	1.2	5355.26	W I	1.6	5365.89	La I
40	5349.30	Sc I	1.2	5355.31	Nb I	1.2	5365.95	Ta I
0.8	5349.31	Rh I	2.0	5355.51	Mo I	2.5	5366.65	Ti I
16	5349.47	Ca I	2.5	5355.62	Ce I	1.6 d	5366.90	Ce
4	5349.57	Ta I	2.0	5355.70	Nb I	2.0hl	5367.11	Mo I
4	5349.58	Nd I	24	5355.75	Sc I	1.4 h	5367.46	Fe I
13	5349.71	Sc I	5 h	5355.88	Sm I	2.5	5367.56	Ce
1.0	5349.79	Mo I	1.6	5355.96	Ce	3.0	5367.70	Gd I
1.6	5349.88	Mn I	60	5356.10	Sc I	1.6	5368.08	Ce
1.8	5349.92	U	2.0	5356.47	Rh I	4	5368.20	Dy II
2.5	5350.09	Zr II	4	5356.48	Mo I	20	5368.36	Sm I
7	5350.30	Sc I	20	5356.98	Nd II	2.5	5368.43	U
2.5	5350.35	Zr II	1.2	5357.12	W I	1.2	5368.70	W I
28	5350.38	Gd I	1.6	5357.19	Sc II	3.0	5368.79	Gd I
2.0 h	5350.41	Eu I	5	5357.20	Ce I	4	5368.85	Er
5	5350.44	Er I	36	5357.61	Eu I	1.2	5368.99	Pt I
3.0	5350.44	W I	4	5357.79	Gd II	4	5369.12	Ce I
2000	5350.46	Tl I	8	5357.86	La I	2.0	5369.18	Sm II
4	5350.60	Ce	1.8	5358.66	Yb II	2.0	5369.26	Dy II
6	5350.62	Sm I	3.0	5358.99	Pr I	1.4	5369.39	Zr I
16	5350.74	Nb I	1.6	5359.18	Co I	3.5	5369.48	Re I
2.0	5350.90	Zr I	4	5359.18	Gd I	4	5369.58	Co I
7	5351.08	Ti I	1.4	5359.19	Nb I	3.0	5369.61	Gd I
1.2	5351.13	Th I	2.0	5359.30	Ce I	5	5369.64	Ti I
2.0	5351.30	Ce	2.5	5359.48	Ce II	8	5369.72	Tb I
1.8 h	5351.33	Yb I	3.0	5359.95	Ce I	5 c	5369.80	Re I
5 h	5351.69	Eu I	10	5359.99	Ho	9	5369.92	Gd I
2.0	5351.90	W I	34 hl	5360.56	Mo I	2.0	5369.96	Fe I
2.0	5351.92	Zr I	4	5360.83	Eu I	3.0	5370.06	Sm I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
1.6	5370.16	Nd	1.0	5382.94	U I	8	5392.94	Eu I
2.5	5370.32	Ce	3.0	5383.37	Fe I	2.0	5393.18	Fe I
14	5370.63	Gd I	2.5	5383.43	V I	32	5393.39	Ce II
	5370.74	Gd I	3.5	5383.85	Nd II	2.0 h	5393.85	Ho I
12	5371.49	Fe I	1.0	5384.04	Th I	4	5394.48	Sm II
2.0	5371.60	Ce I	1.6	5384.08	Ce	4	5394.52	Mo I
17	5371.94	Nd II	4	5384.15	Gd I	8	5394.67	Mn I
3.5	5372.22	Gd II	3.5	5384.56	Ho I	1.0	5394.76	Th I
1.6	5372.37	Pr I	3.5	5384.97	Ho I	6	5394.84	Ce
2.0	5372.40	Mo I	3.0	5385.14	V I	4	5395.24	Ce I
1.6	5373.01	Ta I	22	5385.14	Zr I	4	5395.24	Pd I
2.0	5373.01	Tm II	4	5385.39	Gd I	5	5395.58	Dy I
1.0	5373.45	U	1.0	5385.54	U I	3.0	5395.70	Ce I
7	5373.86	Hf I	2.5	5385.65	Dy II	1.0	5395.86	Nb I
2.0	5374.16	W I	5	5385.88	Ru I	4	5395.87	Er II
1.6	5374.24	Pr I	12	5385.90	Nd II	1.4	5395.88	Zr I
1.8	5375.27	Nb I	5	5386.21	U II	2.5 c	5395.89	Pr I
30	5375.35	Sc I	8	5386.35	Ce I	3.0	5395.99	Ta I
3.5	5375.35	Th II	3.0	5386.62	Th I	1.4	5396.33	Nb I
2.0	5375.77	Th II	2.5	5386.65	Zr I	1.6	5396.60	Ti I
8	5375.98	Tb I	6	5386.76	Ce	2.0	5396.72	Nd
10	5376.79	Os I	2.5	5386.98	Cr I	8	5397.09	Ti I
7	5376.94	Eu I	1.8	5387.57	Cr I	7	5397.13	Fe I
10	5377.09	La II	5	5387.97	Sm I	2.0	5397.38	Mo I
10 c	5377.10	Re I	2.0	5388.02	W I	2.0	5397.56	Ta I
1.2	5377.44	Pr	2.5	5388.23	Nd	16	5397.64	Ce I
8	5377.63	Mn I	0.8	5388.30	Nb I	0.8	5397.87	V I
4	5377.79	Nd I	1.0	5388.30	V I	1.6	5397.90	Tb
5	5377.84	Ru I	2.0 c	5388.51	Ta I	1.6	5397.96	Ce
2.0 w	5377.88	Tb II	1.6	5388.69	Mo I	1.4	5397.97	W I
2.0 h	5378.09	Sm I	4	5389.18	Ti I	2.5 h	5398.26	Dy
2.5	5378.23	Nd I	7	5389.30	Ta I	2.0	5398.91	Th I
2.5	5378.32	Ce	2.5	5389.34	Hf I	2.5	5399.04	Ce I
1.0	5378.84	Th I	8	5389.50	Gd I	2.5	5399.12	Nd II
4	5379.10	Rh I	11	5389.58	Dy II	4	5399.49	Mn I
3.0	5379.89	Ce I	1.6	5389.80	U	4	5399.57	Ce I
1.6	5380.01	La I	3.0	5389.85	Sm I	3.0	5399.94	Dy II
1.2	5380.11	Ce	1.0	5389.87	Yb II	3.5	5400.20	Nd I
5	5380.62	Y I	5	5389.99	Ti I	2.0	5400.46	Tm II
11	5380.99	La II	0.8	5390.39	Cr I	3.0	5400.47	Mo I
0.7	5381.10	Co I	8	5390.44	Rh I	3.5	5400.61	Cr I
1.6	5381.26	Pr II	6	5390.46	Th II	1.2	5400.95	Pr I
2.0	5381.34	Nb I	1.2	5390.79	Pt I	3.0	5400.95	U II
6	5381.40	Ho I	1.4	5391.18	Zr I	8 h	5401.04	Ru I
1.6	5381.70	Pr	1.2	5391.36	Hf II	3.0	5401.21	Ce I
1.0 h	5381.75	Co I	5	5391.88	Ce I	3.0	5401.39	Ru I
6	5381.92	La II	1.0	5391.97	Tm II	7	5401.93	V I
1.6	5382.37	Zr I	42	5392.08	Sc I	3.0 d	5402.06	Tb II
4	5382.61	Ce I	4	5392.58	Th II	2.0	5402.24	Tm I
3.0	5382.93	Th II	3.0	5392.69	Sm I	16	5402.51	Ta I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
1.6	5402.54	Ce	2.5	5411.20	Gd I	2.0	5420.66	Nd I
44	5402.57	Lu I	1.4	5411.24	Nb I	2.0	5420.75	Dy I
2.5	5402.59	Pr I	8	5411.39	Sm I	3.5	5421.07	Eu I
30	5402.77	Eu I	1.6	5411.56	Ce	4	5421.19	Gd I
15	5402.78	Y II	5	5411.56	Pr II	2.0	5421.33	Ce
3.0	5402.90	Nd I	2.0	5411.75	Ce I	9	5421.56	Nd II
8	5403.17	Ho I	3.0	5411.86	Eu I	6	5421.57	Sm I
2.0	5403.20	U	2.0	5411.93	Nd I	1.6	5421.84	Th II
1.4	5403.43	Os I	1.2	5412.14	Os I	1.6	5421.86	Zr I
1.0	5403.54	Ta I	2.0	5412.64	Gd II	12 c	5421.90	Lu I
13	5403.70	Sm I	7 cw	5413.19	Pr II	2.5	5422.20	Ce
1.6	5403.82	Tb II	8	5413.20	Gd I	2.5	5422.42	Pr
3.5	5404.02	Ti I	4	5413.39	Gd I	3.0	5422.44	Nb I
3.5 h	5404.15	Fe I	2.0 c	5413.48	Ta I	2.0	5422.80	Er II
6	5404.16	Dy I	1.6	5413.62	Ho II	0.6	5422.89	W I
4	5404.23	Ce	3.0	5413.65	Tb I	9	5423.31	Dy I
1.2	5404.47	Hf I	3.0	5413.69	Mn I	1.0	5423.35	U
2.0 h	5404.73	Rh I	1.4	5413.93	Zr I	2.5	5423.42	Ce I
1.6	5404.81	Pr	3.0	5414.09	Ce I	0.6	5423.93	W I
3.5	5404.96	Ta I	7	5414.66	Er II	1.8	5424.02	Hf I
1.8	5405.00	Cr I	1.0	5414.67	Mo I	1.8	5424.04	Th I
2.0	5405.13	Zr I	3.5	5414.74	Nd I	2.0	5424.07	Nd I
18	5405.23	Sm I	3.0 h	5415.21	Fe I	5 h	5424.07	Rh I
3.0	5405.33	Eu I	10	5415.26	V I	3.5 h	5424.08	Fe I
1.6bl	5405.66	La LaO	2.0	5415.31	Nd I	3.5	5424.08	V I
7	5405.78	Fe I	6	5415.46	Th II	5	5424.10	Tb II
2.0	5405.79	Mo I	2.0	5415.68	La I	4	5424.24	Dy I
1.0	5405.80	Ta I	8	5415.69	Gd I	6	5424.37	Y I
1.0	5405.99	Tm II	5	5415.98	Sm II	22 hl	5424.55	Ba I
2.0	5406.00	U II	5	5416.12	Sc I	1.6	5424.72	Rh I
5	5406.17	Nd II	3.0	5416.20	Tb I	2.0	5425.00	Tb I
2.0	5406.39	Mo I	1.0	5416.30	Nb I	1.6 h	5425.45	Rh I
1.6	5406.61	Ce	11	5416.34	Os I	5	5425.57	Sc I
11	5407.08	Ho I	8	5416.38	Nd II	2.5	5425.63	Sm I
8	5407.42	Mn I	4	5416.69	Os I	5	5425.68	Th II
1.6 h	5407.51	Co I	1.6	5417.03	Y I	4	5426.26	Ti I
7	5407.62	Zr I	2.5	5417.38	Mo I	1.2	5426.36	Zr I
2.0	5407.65	Th I	2.0	5417.49	Th I	1.6	5426.37	Ce I
2.0	5407.66	Ce	2.5	5417.51	Os I	3.0 c	5426.43	Tb I
1.8bl	5407.69	La LaO	1.6	5417.84	Ce II	1.6	5426.61	Ce
1.6	5408.36	Ce	2.0	5418.09	V I	5	5426.71	Dy II
2.5	5408.78	Ta I	3.5	5418.70	Ce I	1.4	5426.89	Mo I
30 d	5409.22	Ce II	3.0	5418.86	Ru I	6	5426.94	Eu I
10	5409.61	Ti I	1.2	5419.07	Sm I	2.5	5427.25	Ce I
120	5409.79	Cr I	10	5419.13	Dy I	1.6	5427.27	Pr I
1.2	5410.24	U I	10	5419.13	Ta I	1.4	5427.47	Tb I
1.4	5410.55	Ta I	1.0	5419.40	W I	0.7	5427.55	Mo I
4 cw	5410.60	Pr II	2.5	5419.88	Gd II	4	5427.59	Ru I
1.8	5410.76	Th I	7	5420.36	Mn I	1.6	5428.00	Pr
1.8	5410.91	Fe I	12	5420.38	Ce I	1.4	5428.28	Ce

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
2.0	5428.42 Zr I		2.5 c	5437.37 Pr I		2.0	5447.74 Gd II	
7	5429.15 Ti I		2.0	5437.38 Th II		1.0	5447.76 Os I	
2.0	5429.30 Nd I		1.6	5437.54 La I		1.4	5447.92 Re I	
5	5429.41 Sc I		0.8	5437.66 V I		0.9	5448.31 Nb I	
2.0	5429.50 Ce		4	5437.75 Mo I		1.0bl	5448.34 Ti TiO	
8	5429.70 Fe I		2.0	5437.76 Zr I		3.0	5448.57 Zr I	
3.0	5429.86 La I		9	5437.88 Lu I		3.0	5448.90 Ti I	
4	5430.24 Ce I		3.0	5437.90 Ce		2.0	5449.16 Ti I	
2.0	5430.54 Ce		1.4	5438.12 Tb I		15	5449.22 Ce I	
8	5430.79 Nd I		5	5438.22 Sc I		6	5449.24 Nd I	
1.0	5431.02 Mo I		13	5438.24 Y I		2.5	5449.30 Yb II	
1.0	5431.11 Th I		1.6	5438.32 Ti I		1.8	5449.37 Os I	
1.0	5431.26 Nb I		2.0	5438.43 Ce I		3.5	5449.47 Th II	
3.0	5431.33 Ce		2.5	5438.74 Hf I		6.0	5449.50 Ir I	
18	5431.53 Nd II		6	5439.03 Sc I		2.0	5449.8 Ho II	
1.8	5431.66 Ta I		2.0 l	5439.21 Ru I		1.6	5449.86 U	
2.5	5431.90 Re I		1.0	5439.52 Rh I			5449.93 U	
2.5	5432.07 Pr		0.9	5439.71 Mo I		2.5	5450.04 Ce I	
4	5432.36 Nd II		0.8	5440.08 W I		2.5	5450.51 Mo I	
1.4	5432.45 Tb II		1.2	5440.41 Zr I		15	5450.84 Sr I	
3.0	5432.55 Mn I		4	5441.26 Nd		12	5451.09 Dy I	
1.6	5432.64 Pr		1.0 h	5441.36 Rh I		12	5451.12 Nd II	
0.8	5432.74 Yb II		2.5	5441.58 Gd I		2.0 h	5451.30 Er	
1.6	5432.91 Pr I		1.4	5441.82 Os I		13	5451.34 Sc I	
4	5432.94 Sc I		10	5442.27 Nd II		25	5451.51 Eu I	
6	5433.23 Sc I		1.0	5442.41 Cr I		3.5	5451.72 Ce I	
2.5	5433.34 Ce I		6 h	5442.60 Sc I		3.5 h	5451.9 Ho I	
2.5	5433.55 Sm I		3.0	5443.11 Th I		2.5	5452.22 Th I	
0.8	5433.69 Th II		5	5443.31 Os I		0.8	5452.30 Co I	
2.5	5433.82 Sm I		4	5443.35 Dy II		1.0	5452.71 Ru I	
3.0	5434.18 V I		3.5	5443.38 Tb I		5	5452.92 Hf I	
1.8	5434.39 Ho II		2.5	5443.56 Eu I		17	5452.94 Eu I	
5	5434.53 Fe I		0.9	5444.07 Hf II		30	5453.00 Sm I	
5	5435.06 W I		0.8 h	5444.32 Rh I		0.9	5453.03 Mo I	
1.0	5435.12 Th II		3.0	5444.48 U II		1.8	5453.40 Os I	
5	5435.27 Ta I		2.5 h	5444.57 Co I		6	5453.46 Gd I	
1.0	5435.61 W I		1.0 h	5445.04 Fe I		3	5453.57 Lu I	
3.5	5435.68 Mo I		3.0 h	5445.23 Rh		3.5	5453.65 Ti I	
0.8	5435.78 Hf I		3.5	5445.39 Ho I		4	5453.95 Ce I	
2.0	5435.87 Ho I		2.5	5445.43 Ce I		1.6	5454.0 Ho	
0.6	5435.87 Ni I		1.4 h	5445.43 Pr		4	5454.27 Er II	
4	5435.88 Th II		2.5	5446.20 Ce I		2.5	5454.50 Ir I	
1.6	5436.09 Ce		30	5446.20 Sc I		2.0 h	5454.56 Co I	
4	5436.30 Gd I		3.0	5446.45 Ce		6 h	5454.82 Ru I	
4	5436.33 Sm I		4	5446.64 Ti I		38	5455.15 La I	
2.5	5436.73 Ti I		6	5446.92 Fe I		3.5	5455.21 Sc I	
0.8 h	5436.99 Co I		2.0	5446.93 Os I		3.0	5455.31 Gd I	
1.4	5437.03 Re I		3.0	5447.28 Nd I		4	5455.45 Dy II	
1.4	5437.10 Tb I		2.0	5447.39 Sc I		4	5455.61 Fe I	
5	5437.27 Nb I		4	5447.56 Nd II		8	5455.82 Nd II	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
7	5456.13 Ru I		1.0	5466.92 La I		2.0	5475.90 Mo I	
0.9	5456.19 Nb I		0.9 h	5468.10 Nb I		1.0	5476.12 Rh I	
5	5456.41 Ce I		2.0 h	5468.11 Rh I		180	5476.69 Lu II	
2.0	5456.46 Mo I		10	5468.32 Er I		14	5476.91 Ni I	
3.5	5456.56 Nd		15	5468.37 Ce I		1.2	5476.96 Tb I	
2.0	5456.59 W I		6	5468.40 Sc I		1.0	5477.08 Co I	
20	5456.60 Er I		7	5468.47 Y I		0.8	5477.27 Os I	
3.0	5457.00 Tb I		3	5469.11 Dy II		0.8	5477.40 Zr I	
1.6	5457.06 Pr I		0.8	5469.30 Co I		1.6	5477.43 Ce	
4	5457.21 Ce I		0.6	5469.40 Ir I		2.0	5477.45 Er II	
2.0	5457.30 Os I		1.0	5469.71 Pr I		11 h	5477.71 Ti I	
1.0	5457.47 Mn I		4	5469.72 Gd I, II		3.5	5477.80 W I	
2.5	5457.62 Eu I		2.0	5469.92 Pr I		3.5	5478.29 Sm II	
1.6	5457.89 Ce		2.5	5470.00 Os I		3.0	5478.33 Zr I	
0.6	5457.94 W		3.0 w	5470.34 Tb II		1.4	5478.50 Pt I	
1.8	5458.04 Nb I		1.0	5470.46 Co I		0.8	5478.52 Yb II	
1.2	5458.12 V I		5	5470.64 Mn I		3.0	5478.60 Ce I	
2.0	5458.41 Ta I		3.0 h	5470.85 Rh I		3.0	5478.61 Nd I	
2.0	5458.60 Nd		7	5471.21 Ti I		4	5479.40 Ru I	
2.5	5458.69 La II		0.9	5471.33 V		3.5	5479.73 Pr I	
3.0	5458.81 Ce I		10	5471.55 Ag I		2.0	5480.23 Gd I	
6	5459.21 Ce II		1.0	5471.56 Ta I		6	5480.28 U II	
1.6	5459.27 U I		2.0	5471.90 Dy II		2.0	5480.30 Ru I	
6	5459.81 Tb I		7	5472.19 Sc I		1.6	5480.50 Cr I	
6	5460.09 Ce I		15	5472.30 Ce II		2.0	5480.73 La II	
2.5	5460.25 Pr I		6	5472.32 Eu I		6	5480.74 Y II	
5	5460.51 Ti I		3.5	5472.70 Ti I		3.0	5480.83 Zr I	
1.6	5460.53 Mo I		3.0	5472.83 Ce		70	5480.84 Sr I	
2.5	5460.64 Re I		4	5473.08 Nd II		1.8	5481.00 Nb I	
320	5460.74 Hg I		0.8	5473.37 Mo I		1.2	5481.16 Ta I	
7	5461.29 Ta I		6	5473.39 Y II		0.8	5481.16 Zr I	
2.5	5461.55 Sm I		6 d	5473.53 Ce I		2.0	5481.18 Ce	
2.0	5461.74 Th II		4 h	5473.55 Ti I		6	5481.22 U II	
1.0	5461.96 Tm II		1.4 h	5473.69 Ba I		3.5	5481.40 Mn I	
4	5462.45 Er II		8	5474.23 Ti I		1.0	5481.42 Rh I	
2.5	5462.61 Th II		3.0	5474.46 Ti I		10	5481.43 Ti I	
2.0	5463.38 Hf II		1.2	5474.58 Os I		2.5	5481.45 Tb I	
1.6	5463.97 Cr I		2.0	5474.64 Sc		1.4	5481.76 Pr I	
1.0	5464.15 Tm I		5	5474.73 Nd II		1.4	5481.85 Os I	
6	5464.20 Ce II		1.6	5474.86 Th II		7	5481.87 Ti I	
3.5	5464.38 La II		0.8	5474.92 Zr I		3.5	5481.94 Yb I	
2.0	5464.39 Tb I		1.0	5475.11 W I		85	5481.99 Sc I	
2.0	5465.20 Sc I		1.2	5475.13 Os I		6	5482.00 Ce I	
10	5465.34 Ce I		3.0	5475.17 La I		2.0	5482.01 Gd I	
100	5465.49 Ag I		1.0 h	5475.18 Ru I		5	5482.27 La II	
1.0	5465.54 Tm II		2.5	5475.54 Ta I		4	5482.55 U II	
1.4	5465.57 Mo I		3.0 c	5475.67 Pr		0.6	5483.09 Nb I	
3.0	5465.69 U		2.0	5475.72 Gd I		2.0	5483.12 Nd II	
48	5466.46 Y I		7	5475.72 U		5	5483.34 Co I	
19	5466.72 Sm I		1.4	5475.77 Pt I		3.0 h	5483.38 Ce	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
1.6	5483.43 Ta I		2.0	5493.42 Gd I		2.0	5502.25 La I	
0.9	5483.49 Nb I		3.0	5493.45 La II		1.4	5502.67 La I	
1.0	5483.96 Co I		32	5493.72 Sm I		3.0	5502.80 Dy I	
2.0	5484.12 Th II		1.6 h	5493.80 Mo I		2.5	5503.45 W I	
1.4	5484.23 Rh I		7	5494.01 Nd II		20	5503.45 Y I	
6	5484.32 Ru I		2.5	5494.67 U		1.6 h	5503.54 Mo I	
1.0	5484.52 U		1.6	5494.78 Ta I		7	5503.81 La I	
60	5484.62 Sc I		3.0	5495.20 Eu I		10	5503.90 Ti I	
1.4	5484.64 Ru I		2.5	5495.59 Y I		3.5	5504.15 U II	
5 h	5485.10 Nd II		0.5	5495.67 Co I		35	5504.17 Sr I	
9	5485.42 Sm I		0.6	5495.82 Th II		1.6	5504.30 Th I	
1.4	5485.53 Pr I		0.8	5496.13 Th I		3.5	5504.51 Ho I	
19	5485.70 Nd II		0.9	5496.24 W I		2.0	5504.58 Nb I	
9	5485.93 Er II		2.0	5496.42 Nd I		0.8	5504.65 Rh I	
1.4	5486.01 W I		3.0	5496.43 U I		2.0	5504.87 V I	
2.5	5486.09 Zr I		2.0	5496.69 Ru I		2.5 h	5505.11 Gd I	
11	5486.12 Sr I		3.5	5496.84 Dy I		2.5	5505.50 Yb I	
1.4	5486.61 Pr I		0.8 h	5496.94 Mo I		1.6	5505.66 Ta I	
3.0	5487.02 U II		1.4 c	5497.24 Pr I		2.5	5505.87 Mn I	
2.5	5487.03 Nd II		1.0	5497.30 Hf I		4	5506.00 La I	
1.8	5487.22 V I		3.0	5497.41 Er II		1.0	5506.09 Ce	
4 d	5487.41 Pr I		16	5497.41 Y II		1.4	5506.45 Ce I	
	5487.58 Pr I		1.6	5497.52 Fe I		480	5506.49 Mo I	
0.9	5487.78 W I		5	5498.19 Ce I		3.5	5506.52 Dy I	
6	5487.92 V I		11	5498.21 Sm I		2.0	5506.78 Fe I	
8 h	5488.20 Ti I		1.6	5498.49 Mo I		2.0	5507.66 Nd	
1.2	5488.26 Tb II		3.5 c	5498.57 Ho I		5	5507.75 V I	
2.0	5488.63 Th II		2.5	5498.75 Gd I		2.0	5507.87 Zr I	
8	5488.65 Eu I		1.4	5498.86 Nd I		4	5508.40 Nd II	
0.8	5488.67 Mo I		2.5	5499.26 Th I		0.9	5508.63 W I	
2.5	5488.91 U		4	5499.44 Ta I		3.5	5508.79 Pr	
1.4	5488.93 Pr I		0.8	5499.53 Nb I		0.8	5509.12 Nb I	
0.9 h	5489.65 Co I		3.5	5499.97 Gd I		6	5509.15 Pr II	
1.8	5489.94 V I		1.2	5500.10 Tb II		2.0	5509.33 Os I	
3.0	5490.11 Ta I		1.2	5500.32 Tm II		6	5509.61 Tb I	
14	5490.15 Ti I		3.5	5500.43 Gd II		17	5509.90 Y II	
2.0	5490.28 Mo I		2.5	5500.51 W I		3.0	5509.99 Th I	
1.4	5490.56 Pr I		1.4	5500.68 Ta I		0.5	5510.00 Ni I	
2.5	5490.84 Ti I		1.4	5500.69 U I		1.0	5510.12 Hf I	
0.6	5491.06 Nb I		1.0	5500.83 Eu I		3.0	5510.44 U	
2.0	5491.07 La I		1.0	5501.02 Ru I		1.0	5510.45 Hf I	
3.0	5491.15 Ce I		36	5501.34 La I		8	5510.52 Eu I	
3.0	5491.24 U		1.0	5501.47 Fe I		1.0	5510.67 Th II	
1.2	5492.17 Mo I		4	5501.47 Nd I		3.0	5510.68 Ce I	
4	5492.30 Nd I		1.4	5501.47 Pr I		10	5510.71 Ru I	
6	5492.32 W I		1.4	5501.49 U		4	5511.09 Sm I	
2.5	5492.37 Pr		3.0	5501.54 Mo I		1.0	5511.18 V I	
14	5492.97 U II		1.4	5501.87 Mo I		0.7	5511.49 Mo I	
4	5493.17 Y I		1.0	5501.93 Th II		4	5511.49 U I	
1.6	5493.34 Nd I		11	5502.12 Zr I		1.4 c	5511.66 Pr	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
4	5511.78	Ti I	0.8	5521.01	W I	2.0	5529.07	Nd I
28	5512.09	Ce II	2.5	5521.10	Re I	1.4	5529.87	La I
11	5512.10	Sm I	0.7	5521.15	Ta I	1.2	5530.19	Pr I
1.5	5512.37	Ru I	0.8	5521.17	Mo I	2.5	5530.49	Ti
32	5512.53	Ti I	8	5521.63	Y I	2.0	5530.77	Co I
1.6 c	5512.82	Nb I		5521.70	Y II	0.9	5530.99	Ru I
2.5 h	5512.96	Ca I	2.5	5521.75	Gd I	4	5531.15	Pr I
1.4 h	5513.11	Ce II	1.0	5521.75	Th I	1.4	5531.26	U I
1.4	5513.39	U	0.9	5521.78	Ru I	1.4	5531.38	W I
5	5513.58	Pr II	26	5521.83	Sr I	1.0	5532.06	La I
4	5513.64	Y I	1.4	5522.17	Nd I	1.6	5532.30	Zr I
65	5514.22	Sc I	4	5522.46	Ce I	5 c	5532.68	Re I
2.0	5514.23	Ce	4 c	5522.80	Pr I	320	5533.05	Mo I
26	5514.35	Ti I	1.4	5523.29	Co I	2.0	5533.25	Eu I
5	5514.54	Tb I	24	5523.53	Os I	2.0	5533.37	Gd I
30	5514.54	Ti I	2.5	5523.57	Nb I	10	5533.82	Nd I
20	5514.70	W I	2.0	5523.94	Nd I	3.5	5534.33	Ho I
1.6	5514.87	Th I	0.8	5523.98	Ta I	20	5534.81	Sr I
2.5	5515.11	Pr	7	5524.12	Tb I	2.5	5535.04	Rh I
3.0	5515.28	La I	2.5 c	5524.14	Pr I	13	5535.18	Pr II
1.8	5515.39	Sc I	2.0	5524.22	Th II	10	5535.24	Ce I
3.0	5515.40	Dy II	1.2	5524.35	Hf II	6	5535.27	Nd II
3.0	5515.56	Ho II	1.0	5524.55	Yb I	650	5535.48	Ba I
2.0	5515.61	Gd I	1.0	5524.58	Th I	7	5535.67	La II
3.0	5516.00	Er I	1.8	5524.60	Gd II	1.4	5535.80	U
0.8	5516.01	Os I	0.8 h	5524.98	Co I	1.2	5536.26	Tb II
3.0	5516.08	Ce II	1.4	5525.61	Sm I	4	5537.07	Sm II
32	5516.09	Sm I	2.5 c	5525.62	Tb II	1.0	5537.12	Th II
1.2 c	5516.27	Ta I	5	5525.72	Nd I	3.5	5537.46	Zr I
2.0	5516.29	Nd I	2.5 c	5525.90	Pr	4	5537.54	Ce I
2.0	5516.45	Ho II	5	5526.06	Sc I	1.4	5537.74	W I
4	5516.77	Mn I	1.4	5526.09	Ce	3.5	5537.76	Mn I
2.5	5517.11	Zr I	2.5	5526.52	Mo I	2.5	5537.77	Nd II
5	5517.34	La I	2.0	5526.63	Eu I	3.0	5538.02	Hf I
0.8	5517.39	Nb I	1.6	5526.76	Y I	1.8	5538.26	Hf I
2.0	5517.40	Ce	75	5526.82	Sc II	2.5	5538.32	Gd II
1.0	5517.86	Ce	1.0	5526.82	Tm II	2.5	5538.37	Pr I
0.6	5517.86	Ru I	3.5	5526.85	Ce	2.0	5538.53	U
0.8	5518.05	Zr I	2.5	5526.97	Mo I	1.8	5538.77	Pr
6	5518.49	Ce II	2.5	5527.18	Ce I	1.0	5539.03	Tm II
7	5518.91	Ta I	50	5527.54	Y I	5 h	5539.09	Yb I
1.6	5518.99	Th I	6	5527.85	U II	3.0	5539.26	Nd II
32 hl	5519.05	Ba I	1.4 c	5527.88	Pr	4	5539.26	Th I
1.2	5519.38	Pr II	1.0 h	5528.00	Th II	2.5	5539.41	Mo I
1.8 c	5519.84	Pr	4	5528.03	Dy I	0.8	5539.49	W I
1.4	5520.04	Mo I	1.8	5528.32	Tm I	2.5	5539.81	Gd II
1.4 h	5520.05	Re I	4	5528.33	Nd II	6	5539.90	Th II
75	5520.50	Sc I	1.0	5528.36	Ta I	20	5540.05	Sr I
3.0 d	5520.60	Nd	6	5528.41	Zr I	3.0	5540.58	Ce
1.6	5520.64	Mo I	6 h	5528.46	Mg I	1.8	5540.66	Ru I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum
6	5541.04	Sc I
5	5541.26	La I
1.2	5541.47	Nb I
2.5	5541.63	Y I
0.8	5541.65	Mo I
1.6	5542.19	Dy I
2.0	5542.54	Eu I
3.0 d	5542.71	Ce
6	5542.80	Pd I
1.6	5542.88	Th I
3.0	5543.12	Mo I
6	5543.24	Nd I
2.5 h	5543.36	Sr I
2.5	5544.49	Mo I
1.8 l	5544.58	Rh I
8	5544.61	Y I, II
2.0	5544.65	Ce I
2.5	5544.82	U
1.8	5544.91	La I
2.0	5545.01	Gd II
5	5545.01	Pr II
0.8 l	5545.14	Ta I
4.0	5545.32	Zr I
5	5545.91	Nd II
1.6	5545.93	V I
6	5546.02	Y II
0.8	5546.10	Th
3.5	5546.40	Sc I
2.0	5546.52	Ce
2.0	5546.82	Os I
4	5547.02	Pd I
5	5547.07	V I
8	5547.28	Dy I
13	5547.44	Eu I
1.4 h	5547.48	Ce
1.4	5548.06	U
3.0	5548.18	Th I
2.5 d	5548.20	Gd I
1.8	5548.31	Pr
1.6	5548.32	Ta I
6	5548.47	Nd II
3.0	5548.68	Nd
7	5548.82	Ce I
7	5548.95	Sm I
0.8	5549.79	Os I
3.5	5550.04	Ce II
3.0	5550.09	Nd II
1.8	5550.21	Gd I
2.0	5550.40	Sc I
20	5550.40	Sm I
15	5550.60	Hf I
2.0	5550.64	Ce
4	5551.35	Nb I
2.0	5551.36	Th II
1.4	5551.41	Ce I
2.5	5551.44	U II
1.8bl	5551.75	Zr ZrO
1.8	5551.98	Mn I
15	5552.12	Hf I
0.6	5552.19	Mo I
0.6	5552.25	Sc II
1.0	5552.30	Ce I
1.0 c	5552.35	Bi I
1.6	5552.62	U II
1.2	5552.88	Os I
3.0	5553.14	Ho I
2.0bl	5553.17	Zr ZrO
1.0	5553.40	Pr
4	5553.59	Sc I
1.4 h	5555.77	U
12	5556.25	Ce I
3.5	5556.28	Mo I
1.2	5556.30	Tb II
5	5556.43	Y I
140	5556.48	Yb I
0.9	5556.52	Ru I
1.6	5556.72	Mo I
6	5556.95	Ce
2.0	5557.04	Th I
1.0	5557.30	Th II
4	5557.62	Nd II
2.0	5557.90	U II
4	5558.35	Th I
1.4	5558.66	Ce
2.5	5558.75	V I
0.4	5558.82	Co I
6	5559.22	Ce I
2.0	5559.73	Gd I
7	5559.75	Ru I
0.6	5559.88	Th I
1.4 h	5560.06	Ce
1.0	5560.62	Os I
3.0	5560.69	Gd II
4 c	5560.94	Ho I
1.8	5561.10	Sc I
6	5561.17	Nd I
2.0	5561.37	Sm I
1.6 h	5561.46	Ce II
2.0	5561.46	Pr
2.0	5561.66	V I
4 c	5562.06	Pr I
2.0	5562.07	Yb I
1.4 h	5562.21	Ce I
0.7	5562.49	Mo I
2.0	5562.50	Dy I
1.4	5563.00	Nb I
5	5563.03	Ce
5 c	5563.24	Re I
4 b	5563.6	Ho HoO
1.2	5564.05	Mo I
6	5564.17	U I
5	5564.19	Th II
4	5564.24	Ce I
8	5564.86	Sc I
18	5564.96	Ce I
3.0	5565.28	Ce
4	5565.44	La I
10	5565.49	Ti I
1.2	5565.54	Pr I
3.0	5565.72	La I
3.5	5565.93	Tb I
14	5565.97	Ce I
2.0	5566.01	Tm I
2.0	5566.50	Ce
8	5566.52	Ho I
1.2	5566.92	Pr
1.8	5566.94	La II
4	5567.75	Y I
0.7	5567.76	Mn I
5	5567.81	Ce I
3.0	5568.00	Th II
1.2	5568.07	W
1.2	5568.11	Yb I
6	5568.46	La I
2.5	5568.62	Mo I
0.8	5569.03	Ru I
1.4 h	5569.29	Ce
1.6	5569.48	Mo I
2.0	5569.62	Fe I
4	5569.96	Nd II
10	5570.33	Eu I
1.2	5570.38	La I
150	5570.45	Mo I
3.5	5570.68	U
3.0	5571.20	Th I
2.0	5571.24	Sc I
0.8 c	5571.44	Nb I
4	5571.84	Pr II
2.0	5572.19	Ce I
1.4	5572.47	Th I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
2.5	5572.53	Gd I	8	5582.74	Ce I	5 d	5591.85	Gd I
1.2	5572.82	Tb I	2.0 h	5582.98	Ti	1.2	5592.25	Eu I
3.0	5572.85	Fe I	5	5583.68	Gd II	1.0	5592.28	Ni I
0.6	5573.01	Mn I	1.8	5583.76	Th II	6 bl	5592.3	Ho HoO
1.2	5573.07	U I	1.0	5584.01	Pr	7	5592.42	V I
3.5	5573.35	Th I	2.5	5584.02	Ta I	2.0	5592.67	Nd I
6	5573.42	Sm I	7	5584.44	Os I	4 h	5593.38	Sc I
2.5	5573.47	Re I	10	5584.50	V I	9	5593.43	Er I
1.0	5573.59	U I	4 bl	5584.7	Ho HoO	2.0	5593.62	Th II
0.7	5573.68	Mn I	3.5	5584.72	Ce I	3.0	5593.72	Ce I
2.0	5573.96	Ho II	2.5	5584.72	Re I	1.4	5594.12	Y I
1.0	5574.60	Pr	3.0 h	5585.68	Ti	3.5	5594.13	Gd I
4	5574.89	Sm I	1.6	5586.00	V I	26	5594.43	Nd II
1.4 h	5575.08	Ce	1.2	5586.16	Gd II	36	5594.45	Ca I
2.0	5575.19	Mo I	6	5586.24	Eu I	0.6	5594.89	Nb I
3.0	5575.50	Nd I	2.0	5586.32	Gd I	2.0	5594.92	Pr I
3.5	5575.86	Hf I	1.2	5586.35	Yb I	7	5594.94	Ce I
2.0 d	5575.98	Th I	1.0	5586.66	Tm II	2.0	5595.07	Th I
	5576.21	Th I	2.0 h	5586.72	Ce	2.0	5595.81	Nd
0.7	5576.11	Fe I	4	5586.76	Fe I	11	5595.87	Ce I
3.5	5576.13	Gd I	5	5586.83	Eu I	0.6	5596.32	Mo I
1.6 c	5576.16	Nb I	2.0	5586.96	Tb I	1.8	5597.21	Gd II
0.6	5576.34	W I	2.5	5586.97	Nb I	2.0	5597.29	Pr
3.0	5576.70	Nd I	5	5587.03	Th I	2.5	5597.38	U II
13	5577.14	Eu I	1.0	5587.19	U	6 bl	5597.85	Ti TiO
2.0	5577.28	Ce	3.0	5587.61	Nd I	3.5	5597.95	Ce I
12	5577.42	Y I	2.0	5587.72	Th II	24	5598.47	Ca I
3.0	5577.70	Nd I	0.7	5587.86	Ni I	0.5	5598.47	Mo I
3.5	5578.27	Ce	2.0	5587.96	Nd II	1.2	5598.75	Ta I
1.6	5578.29	Nb I	1.4	5588.12	Ce	2.5	5598.96	Ce I
1.6	5578.40	Ru I	5	5588.20	Sm I	14	5599.42	Rh I
2.5	5578.66	Nd	3.0	5588.33	Ce I	2.5	5599.52	Ta I
0.5	5578.73	Ni I	6	5588.34	La I	0.8 c	5599.59	Nb I
1.0	5578.81	Pr I	2.5	5588.47	Yb II	1.2	5599.80	Eu I
3.0	5578.89	Ce I	70	5588.75	Ca I	6 bl	5600.02	La LaO
1.2	5579.16	Ti	2.0	5588.87	Th I	0.7	5600.50	Os I
3.0	5579.36	Th I	3.5	5588.91	Nd	5 d	5600.71	Dy II
5	5579.63	Eu I	1.0	5589.25	Ce	0.9	5600.77	Hf I
1.6	5579.76	Sc I	2.0	5589.56	Tb I	7	5600.86	Sm II
8	5580.03	Eu I	1.0	5589.95	Tm II	0.9	5601.05	Mo I
1.4	5580.66	Os I	10	5590.11	Ca I	5 d	5601.19	Er I
1.8	5580.82	U II	1.0	5590.13	Ce	12	5601.26	Ca I
1.6	5581.08	Y I	1.4	5590.53	Ce I	26	5601.30	Ce I
2.5	5581.23	U	1.8	5590.73	Co I	1.2	5601.31	Pr
1.6	5581.36	Tm I	0.8 c	5590.95	Nb I	2.0	5601.38	V I
3.5	5581.60	Nd II	1.4	5590.96	Y I	6	5601.43	Nd I
4	5581.61	U II	6 b	5591.1	Ho HoO	0.6	5601.60	Th I
42	5581.87	Y I	12	5591.33	Sc I	5	5601.92	Nd I
12	5581.97	Ca I	1.2	5591.58	Mo I	8 bl	5602.50	La LaO
1.2	5582.40	Pr II	1.2	5591.62	Tb II	4	5602.68	Nd II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
2.5	5602.76 Mo I		1.6	5614.01 Hf I		0.5	5624.58 W I	
12	5602.84 Ca I		4	5614.30 Nd II		14	5624.60 V I	
2.0	5602.91 U II		2.0	5614.45 Gd I		5	5624.89 V I	
0.8	5602.96 Fe I		8	5614.72 Ce I		1.2	5625.23 Ce	
1.6	5603.14 Ru I		0.7	5614.79 Ni I		0.4 h	5625.33 Ni I	
2.0	5603.52 Nb I		3.0	5615.32 Th I		3.5	5625.55 Ir I	
0.6	5603.55 Ru I		2.0	5615.35 Nd I		4	5625.72 Nd II	
3.0	5603.65 Nd II		5	5615.65 Fe I		10	5626.01 Sm I	
0.6	5603.93 Nb I		2.0	5615.68 Th II		4	5626.01 V I	
1.2	5603.99 U		1.8	5615.98 Ce I		2.5bl	5626.03 La	LaO
2.5	5604.19 Sc I		0.8	5616.19 W		5 b	5626.4 Ho	HoO
1.2	5604.33 W I		2.5	5616.21 Gd II		9	5626.52 Er II	
4	5604.51 Th II		1.0	5616.53 Ce		0.6	5626.73 Th II	
5	5604.94 V I		1.2	5616.58 U I		2.5	5627.49 Dy I	
0.6	5605.28 Th I		0.8	5617.08 W I		7	5627.60 Ho I	
0.7 c	5605.50 Ta I		4	5617.71 Nd II		28	5627.64 V I	
3	5605.64 Dy I		0.7 c	5617.71 Ta I		1.2	5628.02 U II	
8	5605.64 Pr II		18	5617.91 Gd I		1.0	5628.20 Ta I	
1.2	5605.86 Eu I		1.2	5618.45 Mo I		1.2	5628.21 Ce	
8	5606.33 Y I		0.6	5618.77 Mo I		3.5	5628.24 Ho II	
4	5606.46 Ce I		2.5	5618.81 Eu I		1.2	5628.26 Nb I	
1.0	5606.64 Tm I		3.0	5619.00 Nd		0.5	5628.27 Hf I	
1.2	5606.68 Pr		1.4	5619.38 Mo I		3.5bl	5628.60 La	LaO
1.0	5606.73 Ru I		3.0	5619.44 Pd I		2.0	5628.64 Cr I	
3.5 b	5607.1 Ho	HoO	0.8	5620.04 Ir I		2.0bl	5629.02 Zr	ZrO
1.0 h	5607.21 Re I		1.0	5620.07 Pr		3.0	5629.17 Nb I	
0.6	5607.71 Rh I		3.0	5620.08 Os I		5 bl	5629.28 Ti	TiO
1.4	5608.35 Rh I		10	5620.14 Zr I		1.2	5629.46 U	
1.4	5608.62 Mo I		1.8	5620.25 Pr I		6	5629.55 Gd I	
1.2	5608.86 U		1.8	5620.39 Ce I		2.0bl	5629.58 Zr	ZrO
2.5	5608.98 Pr		24	5620.54 Nd I		0.8	5629.65 W I	
1.4	5609.23 Mo I		3.0	5620.68 Ta I		0.8	5629.79 Ru I	
1.2	5609.45 Ce I		5	5620.78 U I		38	5630.13 Y I	
5 h	5609.94 Er I		1.6	5621.43 Gd II		0.6	5630.30 Th I	
5	5610.22 Pr II		2.5	5621.51 U I		2.5	5631.02 Sc I	
1.0	5610.25 Th I		1.2	5621.55 Tb II		12	5631.22 La I	
8	5610.26 Ce II		7	5621.79 Sm I		1.0	5631.26 W I	
1.6	5610.67 Th I		4 c	5621.85 Pr II		20	5631.40 Tm I	
5	5610.89 U I		8	5622.02 Er I		4	5631.71 Sn I	
5	5610.92 Ce I		4	5622.44 Eu I		2.5	5631.97 W I	
6	5610.93 Mo I		1.0	5622.67 Ce		5	5632.03 La I	
7	5611.82 Er I		1.4	5623.00 Ce		10	5632.25 Gd I	
1.0	5612.07 Th I		10	5623.05 Pr II		1.6	5632.25 Y I	
1.0	5612.11 Zr I		3.0	5623.53 Zr I		0.9	5632.46 V I	
1.2 h	5612.27 Re I		1.2	5623.62 Nd I		20	5632.47 Mo I	
1.4	5613.07 Mo I		1.2	5623.75 Ce I		1.2	5632.47 U	
4	5613.24 Dy I		1.0	5623.91 Y I		3.0	5632.48 Ce	
6	5613.27 Hf I		0.9	5624.20 V I		5	5632.54 Eu I	
3.0	5613.64 Ho I		8	5624.43 Pr II		0.4	5632.77 Rh I	
3.5	5613.70 Ce II		1.0	5624.55 Fe I		1.4	5632.89 Y I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
1.0 h	5633.02	Pr I	24	5643.24	Gd I	2.5 b	5654.82	La I, LaO
5	5633.09	Ce I	12	5644.10	Sm I	20	5655.13	Ce I
3.0	5633.49	Gd I	24	5644.14	Ti I	1.5	5655.42	Pd I
0.7	5633.90	V I	0.8	5644.25	U	8 bs	5655.9	Ho HoO
2.5	5634.38	U I	0.4	5644.48	W	1.2	5656.21	Ce
2.0	5634.49	Ce I	8	5644.69	Y I	3.0	5656.34	Sm I
3.0	5634.86	Mo I	2.5	5644.84	Gd II	1.2	5656.54	La I
1.6 c	5635.42	Nb I	2.5	5645.25	Os I	8	5657.44	V I
0.5	5635.50	W	1.6	5645.30	Nb I	10	5657.72	La I
0.9	5635.51	V I	2.0	5645.39	Pr	28	5657.88	Sc II
1.6	5635.71	Ta I	2.0	5645.40	Tm I	1.0	5657.93	Th I
7	5635.76	Nd I	2.0 c	5645.75	Tb I	1.6	5658.26	U I
1.6	5635.84	Ti	14	5645.80	Eu I	5	5658.30	Tm I
0.7 h	5636.12	Co I	4	5645.88	Th II	7	5658.34	Sc II
3.5	5636.22	Er I	12	5645.91	Ta I	2.5 h	5658.48	Er II
22	5636.24	Ru I	7 h	5646.02	Dy I	1.2	5658.83	Fe I
2.0	5636.46	Pr	6	5646.11	V I	7 b	5658.9	Ho HoO
2.0	5636.56	Tb I	5.0	5646.36	Sc I	0.4	5659.11	Co I
0.8	5636.80	U	3.5	5646.58	Ce I	16	5659.58	Ho I
2.0	5637.30	Sm II	2.0	5647.22	Co I	0.8	5659.62	Rh I
5	5637.39	Ce II	1.8	5647.60	Sc I	1.2	5659.78	Ce I
0.8	5637.41	Os I	2.0	5647.98	Nd I	4	5659.78	Nd II
1.2 h	5638.00	U	1.2 h	5648.10	Rb I	5	5659.84	Pr II
3.5	5638.19	Ce I	18	5648.25	La I	20	5659.86	Sm I
1.2	5638.41	Ce	0.8	5648.38	U	0.7	5660.07	W I
1.2	5638.63	Ce I	6	5648.38	W I	0.8	5660.21	Os
5 c	5638.79	Pr II	8	5648.47	Y I	3	5660.75	W I
3.0 c	5638.80	Tb I	7	5648.58	Ti I	1.2	5661.54	Sm II
3.0	5639.31	La I	0.6	5648.98	Os I	2.5bl	5661.55	Ti TiO
13	5639.53	Dy I	1.0 h	5649.37	Cr I	3.0 h	5661.56	Pr I
5	5639.54	Nd I	0.5	5649.56	Ru I	18	5662.16	Ti I
6	5639.75	Th II	6	5649.56	Sc I	1.4	5662.19	Pr II
2.0	5640.11	Ce	0.3	5649.70	Ni I	2.0	5662.46	Nd I
3.0	5640.18	Ta I	14	5650.13	Mo I	7	5662.91	Ti I
1.2	5640.33	U	5	5650.60	Ce I	50	5662.94	Y II
10	5640.34	Er I	1.2	5650.83	Hf I	1.2	5663.18	Ce
1.4	5640.34	Pr I	1.0	5651.11	Eu I	1.4	5663.48	Ce I
6	5640.62	Ho	0.7	5651.87	Mo I	3.0hs	5663.8	Cs I
1.2	5640.79	Ce	3.5	5652.00	Yb II	3.0	5663.91	Sm I
9	5640.98	Sc II	10	5652.01	Dy I	6	5663.99	Ce I
2.5	5641.43	Er I	1.0	5652.90	Th II	0.4	5664.02	Ni I
2.0	5641.52	Dy II	1.2	5652.96	Ce	2.0	5664.04	Cr I
0.8	5641.66	Ru I	0.5	5653.30	Ru I	0.7	5664.34	Mo I
0.7	5642.04	W I	1.2 h	5653.33	Gd I		5664.38	Mo I
8	5642.11	Nb I	4	5653.57	Nd I	0.7	5664.34	W I
0.6	5642.36	Cr I	2.0	5653.79	U	3.5bl	5664.42	Gd GdO
2.0	5642.56	Os I	1.0	5654.01	Th II	13	5664.51	Zr I
3.0	5642.60	Tm I	0.8	5654.14	Nb I	2.0	5664.68	Ce
1.7	5642.69	Pd I	3.0	5654.25	Pr II	6	5664.71	Nb I
1.4cw	5643.20	Pr I	2.0	5654.41	U II	1.2 h	5664.86	U

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
0.8	5664.89	Lu II	6	5675.27	Y I	3.0 c	5685.74	Tb II
10	5664.90	Ta I	0.6	5675.38	W I	5	5685.86	Ce
8	5664.95	Er I	12	5675.44	Ti I	3.5	5686.38	Rh I
1.4	5665.18	Th I	6	5675.49	Er I	4 c	5686.48	Tb I
0.8	5665.20	Ru I	38	5675.85	Tm I	1.4	5686.50	Pr
1.2	5665.26	Nd I	15 d	5675.97	Nd I	0.4	5686.53	Yb II
1.0	5665.38	Ce	6	5676.33	Nd I	2.0	5686.66	Gd I
5	5665.44	Er II	1.2	5676.61	W I	140	5686.84	Sc I
2.5	5665.62	Th II	6	5676.88	Ce	4	5686.84	Sm
8	5665.63	Nb I	1.4	5676.93	W I	2.0	5686.98	Sm I
1.6	5666.28	Zr I	1.4	5677.04	Pr II	2.0 h	5687.19	Pr II
1.4	5666.42	Dy I	1.2	5677.25	Ce	0.6	5687.64	Mo I
0.8	5666.86	Nb I	3.0	5677.45	Gd I	1.2	5687.82	Ce
6	5667.16	Sc II	1.2	5677.47	Nb I	14 l	5688.22	Na I
0.8	5667.30	Mo I	1.8	5677.69	Dy I	2.5	5688.25	Ta I
10	5667.88	Re I	13	5677.76	Ce I	6	5688.46	Pr II
8	5668.36	V I	2.5	5677.89	Mo I	2.5	5688.49	Ce I
6 c	5668.45	Pr I	0.6	5678.97	Th	24	5688.53	Nd II
8	5668.87	Nd II	1.2	5678.98	Ce	28	5689.14	Mo I
10	5668.94	Ce II	1.2	5679.63	Ru I	2.0	5689.18	Pr II
8	5669.04	Sc II	3.0 h	5679.94	Ti I	9	5689.47	Ti I
2.5	5669.42	U I	2.0	5680.18	Ba I	2.5	5689.51	Nd I
4	5669.55	Pr II	1.8	5680.27	Ce	1.2	5690.14	Pd I
7	5669.77	Nd I	1.2	5680.37	U I	5 d	5690.95	Pr PrO
26	5669.97	Ce I	2.5	5680.88	Os I		5691.04	Pr
3.0	5670.02	Pr II	5 bl	5680.89	Gd GdO	3.5	5691.39	U II
8	5670.07	Pd I	10	5680.90	Zr I	1.2	5691.47	Ce
22	5670.85	V I	1.8	5681.10	Eu I	16 c	5691.47	Ho I
3 cw	5671.02	Nb I	1.2	5681.16	Nd I	1.2	5692.05	Sm I
1.8	5671.25	Dy I	0.6 h	5681.20	Cr I	2.5	5692.13	Ce I
1.2	5671.41	Ce	5	5681.90	Pr II	3.5	5692.13	Gd I
4	5671.55	La II	0.9	5682.20	Ni I	13	5692.94	Ce I
170	5671.81	Sc I	0.6 h	5682.48	Cr I	1.2	5693.09	Nb I
8 c	5671.84	Ho	7 l	5682.66	Na I	1.2	5693.63	Y I
2.0	5671.84	Tb I	1.2	5682.78	Ce I	3.5 h	5693.67	Dy II
3.5	5671.87	Ce I	2.0	5682.89	Mo I	3.0 h	5694.10	Dy
4	5671.91	Nb I	1.4	5683.14	Ce	0.6	5694.39	Mo I
0.6	5672.07	Mo I	1.4	5683.22	V I	3.5cw	5694.54	Dy II
2.0	5673.42	Ti I	3.5	5683.33	Gd I	2.0	5694.73	Cr I
0.7	5673.56	W I	1.6	5683.33	U	0.6	5695.00	Ni I
1.4	5673.63	Mo I	1.0	5683.60	Tm I	6 h	5695.09	Pd I
4	5673.85	Eu I	3.0	5683.77	Ce II	1.2	5695.23	Nd I
1.4	5674.13	Pr	2.5	5684.11	Gd GdO	1.6	5695.55	Er II
0.6	5674.38	Os I	11	5684.20	Sc II	2.5	5695.74	Ce
2.5	5674.42	W I	1.8	5684.24	Eu I	8	5695.84	Ce I
3.5	5674.47	Mo I	3.0	5684.77	Tm II	2.0	5695.93	Pr II
7	5674.70	Ho I	1.2	5685.19	U I	0.8	5696.03	Mo I
0.8	5674.88	U	1.2	5685.42	Zr I	7	5696.19	La I
1.2	5674.98	Th I	3.0	5685.60	Dy I	36	5696.22	Gd I
2.5	5675.10	Ce I	1.2	5685.61	Pr II	3.0	5696.24	Sm

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
8 bs	5696.3	Ho HoO	1.8	5706.99	U	4	5716.50	Ce
1.0	5696.44	Tm II	8	5707.10	Th II	0.6	5716.53	Ta I
16 c	5696.57	Ho I	6	5707.61	Pr I	1.8	5716.87	U I
16	5696.73	Sm I	3.5	5708.23	Ti I	1.8	5716.95	Re I
32	5697.00	Ce I	18	5708.28	Nd II	26	5717.28	Sc I
1.4	5697.82	W I	22	5708.61	Sc I	6	5717.48	Er I
1.6 d	5697.90	Nb I	2.5	5708.89	Zr I	4	5717.92	Sm I
	5698.03	Nb I	0.8	5708.95	V I	9	5718.12	Nd II
2.5bl	5698.03	Hf HfO	1.8	5709.06	Ce I	6 bl	5718.21	Zr ZrO
0.7	5698.27	Mo I	1.4	5709.33	Nb I	1.2	5718.36	Ce I
3.5	5698.33	Cr I	1.0	5709.37	Os I	9 h	5718.48	Dy I
85	5698.52	V I	6	5709.42	Gd I	1.2	5718.59	Ce
3.5	5698.75	Dy II	1.0	5709.49	U	26	5719.04	Ce I
5	5698.93	Nd II	1.8	5709.56	Ni I	3.5	5719.09	Nd I
14	5699.05	Ru I	3.0	5709.73	Sm I	4	5719.09	Pr II
40	5699.23	Ce I	2.5	5709.98	Tm II	2.0	5719.16	Sm
3.0	5699.24	Ta I	1.0	5710.07	Ce	10	5719.18	Hf I
1.4	5699.28	Mo I	3.5	5710.32	Gd I	8	5719.53	Er I
1.0	5699.39	La I	0.8	5710.85	La I	1.0	5719.56	Ce I
120	5700.21	Sc I	3.0	5710.89	Er II	4 d	5719.63	Pr
10	5700.24	Cu I	5	5710.93	Sm I		5719.81	Pr
2.0	5700.45	Th II	2.5	5711.43	Re I	1.6	5719.63	Th I
8	5700.69	Th II	5	5711.45	Ce II	0.6	5719.82	Cr I
	5700.90	Th II	2.0	5711.45	Sm I	13	5720.01	Yb I
9	5701.35	Gd I	3.5	5711.65	Pr II	3.5	5720.02	La I
3.5	5701.57	Nd I	100	5711.75	Sc I	1.6bl	5720.16	Hf HfO
0.7	5702.11	Mo I	1.4	5711.80	Mo I	4	5720.19	Sm I
14	5702.24	Nd II	6	5711.88	Ti I	4	5720.20	Th I
2.0	5702.31	Cr I	0.8	5711.90	Ni I	3.5	5720.48	Ti I
6	5702.39	Ce I	1.8	5712.29	Ce I	1.6	5720.61	Y I
0.8 h	5702.47	Rh I	5	5712.40	La II	3.0	5721.38	Sm
7	5702.68	Ti I	1.8	5712.45	Tb II	15	5721.93	Os I
3.0	5702.92	Dy I	1.0	5712.64	Cr I	3.5	5721.96	Ce I
4	5703.23	Ce	2.0	5712.78	Cr I	2.0	5721.99	Gd II
3.5	5703.33	La II	1.6	5713.28	Hf I	1.0	5722.23	U
65	5703.56	V I	1.2	5713.49	Lu II	13	5722.74	Mo I
2.0	5704.07	U	2.0	5713.83	Pr I	0.6	5723.06	W I
1.2	5704.31	Ta I	4 h	5713.92	Ti I	0.7	5723.11	Mo I
2.0	5704.39	Pr I	3.0	5714.02	La I	3.5	5723.63	U II
1.0	5705.66	U	1.0	5714.55	La I	20	5724.08	Sc I
5	5705.72	Mo I	0.8	5715.09	Ni I	2.0 l	5724.45	Rb I
1.4	5705.95	Dy II	9	5715.13	Ti I	1.6	5724.45	Sm I
2.0	5706.16	Nb I	2.5	5715.24	Ta I	4	5724.75	Gd I
12	5706.20	Sm I	4 h	5715.29	Ce II	1.0	5724.82	Ru I
9	5706.21	Nd II	0.8	5715.59	Nb I	2.5	5725.39	Th I
2.0	5706.28	Ta I	1.6	5715.79	Tm I	5	5725.64	V I
4	5706.48	Nb I	1.4	5716.08	Pr	1.2	5725.66	Nb I
11	5706.73	Y I	0.8 h	5716.21	V I	1.0	5725.73	Ru I
3.0	5706.75	Sm I	3.0	5716.35	Nb I	3.5 h	5725.84	Dy II
40	5706.98	V I	5	5716.48	Ti I	1.0	5725.85	Ce I

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1.8	5726.14 Ce		16	5737.06 V I		1.2	5746.49 Ce I	
7	5726.83 Nd II		0.8 h	5737.22 Tm II		1.8	5746.71 Ta I	
6	5726.99 Er I		2.0	5737.27 U I		1.2bl	5746.93 Y YO	
60	5727.03 V I		1.0	5737.36 Nb I		1.8	5747.14 Pr	
2.0	5727.25 Ce		0.7	5737.89 Os I		0.6	5747.26 W I	
2.0	5727.29 La II		4	5738.01 Sm II		1.2	5747.47 Ru I	
0.5	5727.30 Rh I		0.6	5738.20 Nb I		9 c	5747.58 Tb I	
12	5727.66 V I		0.6	5738.29 Mn I		1.0	5747.67 Mo I	
1.0	5728.36 Pr		0.6	5738.29 Th II		1.2	5747.70 V I	
7 h	5728.64 Dy II		3.0 h	5738.73 Dy II		2.0 c	5747.88 Pr	
1.4	5728.77 Mo I		1.0 h	5738.93 Tm II		4	5748.09 Sm I	
5	5728.89 Y II		4	5739.00 Eu I		1.8	5748.13 U	
6	5729.19 Nb I		11	5739.18 Er		3.5	5748.15 Nd II	
11	5729.29 Nd I		6	5739.24 Ho I		3.0bl	5748.17 Zr ZrO	
2.0	5729.30 Sm I		8	5739.51 Ti I		1.0	5748.29 Ce	
1.8	5729.38 Ce		0.5	5739.60 W I		1.0	5748.47 U	
1.6 d	5729.45 Mo I		0.7	5739.66 Mo I		7	5748.65 Er I	
	5729.59 Mo I		0.7	5739.72 Os I		0.8	5748.72 Hf I	
0.9	5729.87 Mo I		5	5739.96 Nd II		0.8	5748.76 Th I	
10 bl	5730.12 Y YO		4	5740.02 Ti I		3.0	5748.87 V I	
1.4	5730.13 Sm		6	5740.19 Dy I		1.8	5748.95 Ce I	
4	5730.87 Eu I		4	5740.62 Er I		3.0	5749.06 Nd	
1.8	5731.05 Nd I		14	5740.66 La I		6	5749.19 Nd I	
16	5731.25 V I		8	5740.86 Nd II		1.2	5749.22 W I	
3.5	5731.87 Pr II		3.0	5740.89 Sm I		2.5	5749.40 Th II	
1.4	5732.09 Y I		1.6	5741.18 Th II		3.5	5749.41 Gd II	
7	5732.95 Sm I		1.4	5741.19 Sm I		2.5	5749.58 Ho I	
2.5	5732.99 Th II		1.8	5741.22 Ti I		3.0	5749.66 Nd I	
2.0	5733.26 U		3.0	5741.28 Nd		0.6	5749.92 Yb II	
2.5	5733.42 Er II		0.9	5741.71 Mo I		3.0	5750.50 Dy I	
1.0	5733.82 Tm II		5	5742.08 Nd II		1.8	5750.54 U	
11	5733.86 Gd II		2.0	5742.09 Th I		38	5751.40 Mo I	
1.8	5733.94 Ce I		3.0	5742.76 Nd		4	5751.44 Nb I	
3.0	5734.01 V I		1.4	5742.94 La I		3.5	5751.88 Gd I	
3.0	5734.02 Ho I		3.5	5743.20 Nd II		0.8	5752.02 Ru I	
1.0	5734.06 Mo I		7	5743.35 Sm II		1.2	5752.52 Ce	
2.5	5734.55 Nd		8	5743.45 V I		6	5752.53 Er I	
3.0	5734.95 La I		10	5743.53 Ce I		1.2	5752.74 V I	
5	5735.09 W I		6	5743.85 Y I		2.0	5752.84 Ti I	
2.0	5735.69 Ce I		1.2	5744.14 Nd II		11 c	5752.93 Re I	
10	5735.70 Zr I		12	5744.41 La I		2.0	5753.02 Pr	
4	5735.98 Gd I		4	5744.66 Gd I		0.8	5753.04 Th I	
2.0	5736.38 U I		2.0	5744.69 Ce		3.0	5753.53 Nd II	
5	5736.4 Ho HoO		5	5744.77 Nd II		0.6	5753.69 Cr I	
48	5736.55 Lu I		1.2	5745.50 Sm I		8 d	5754.17 Gd I	
2.5	5736.58 Er I		7	5745.54 Dy I		0.5	5754.57 W	
2.0	5736.61 Pd I		0.8	5745.68 Th II		1.2	5754.68 Ni I	
3.0	5736.84 Sm I		1.2	5745.99 Ru I		2.5	5755.81 Ta I	
6 bl	5736.85 Sc ScO		8	5746.36 Gd I		0.6 h	5755.90 Yb I	
2.5	5736.96 Er I		0.6	5746.43 Cr I		1.0	5756.09 W I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
8	5756.17	Pr II	3.5	5766.64	Ho	1.0	5776.90	U
0.8	5756.83	Ru I	0.9	5767.18	Hf II	1.4	5777.29	Pr
1.8	5756.86	Ti I	2.5	5767.33	Nd I	50 hl	5777.62	Ba I
8	5757.62	Er II	1.0	5767.43	U I	1.0	5777.81	U
3.0	5757.97	Sm I	2.5 c	5767.91	Ta I	0.6	5778.19	Mo I
2.0	5758.02	Tm I	0.8	5767.92	Ru I	8	5778.33	Sm I
2.0	5758.14	U I	8	5768.90	Ce II	1.4bl	5778.57	Zr ZrO
4	5758.24	Ce I	12	5769.07	La II	0.4	5778.83	Tm II
4	5758.30	Ce	2.0	5769.15	Pr	6	5779.24	Sm I
1.0	5758.35	U I	28	5769.34	La I	8	5779.29	Pr I
3.0	5758.82	Dy I	24 hs	5769.59	Hg I	2.5	5779.36	Mo I
1.4	5759.39	Pr	0.6	5769.75	Mo I	2.0	5780.02	Ta I
6	5759.52	Sm II	1.4	5769.78	Pr	0.6	5780.11	Mo I
0.6	5759.65	W I	4	5769.87	Nd II	0.6	5780.19	Mn I
2.0	5760.00	Nd	8	5769.92	Er I	0.8	5780.34	Nb I
2.0	5760.21	Pr I	2.5	5769.95	Ce I	6	5780.59	U I
4	5760.21	Tm I	6	5769.99	La I	7	5780.71	Ta I
5	5760.34	Nb I	3.5	5770.44	Ce I	3.0	5780.78	Ti I
6	5760.55	Th I	5	5770.50	Nd II	15	5780.82	Os I
1.0	5760.58	Ce	0.6	5771.05	Mo I	1.0 h	5781.20	Cr I
0.6	5760.85	Ni I	1.0	5771.05	U I	7	5781.69	Y II
1.2	5761.41	V I	1.4	5771.08	Nb I	0.5 h	5781.81	Cr I
1.2 h	5761.61	Ta I	2.0	5771.20	Gd II	6	5781.93	Sm II
0.9	5761.62	Tb II	1.6	5771.67	Yb II	40	5782.13	Cu I
3.5	5761.70	Nd II	0.8	5771.93	Ta I	1.4	5782.36	Tm II
12	5761.84	La I	1.4	5771.98	Ce II	4	5782.44	Ce
0.8	5761.88	U	3.5	5772.22	Ce I	1.0 l	5782.60	K I
1.6	5762.08	Nd I	5	5772.42	V I	0.8	5782.61	V I
4 h	5762.27	Ti I	11 bl	5772.74	Sc ScO	1.4	5782.81	Ce I
2.5	5762.66	Tb I	5	5772.88	Ce I	5	5782.81	Er
32	5762.79	Er I	4	5773.11	Pr	2.0 h	5783.11	Cr I
1.2	5763.00	Ce	15	5773.12	Ce I	1.4 h	5783.33	Mo I
0.7	5763.01	Fe I	2.5	5773.59	Ce I	0.8	5783.50	V I
0.8	5763.54	Th I	10	5773.77	Sm I	12	5783.69	Eu I
0.6	5763.57	Pt I	2.5	5773.86	Y I	2.5 h	5783.93	Cr I
1.0 h	5763.63	U I	1.4	5773.95	Pr	1.4	5783.99	Ce II
4	5763.91	Sm I	7 h	5774.05	Ti I	3.0 h	5784.38	V I
1.6bl	5764.22	Y YO	1.4	5774.55	Mo I	1.6	5784.44	Tm I
1.2	5764.23	Nd I	1.6	5774.56	Gd II	8	5784.64	Er I
14	5764.30	Tm I	2.0	5775.00	Ce I	5	5784.85	Ce I
6 bl	5764.45	Sc ScO	6 bl	5775.32	Sc ScO	0.8	5784.86	Th II
2.5	5764.77	Ce	5	5775.40	Lu I	5	5784.96	Nd I
3.0	5764.99	Nb I	1.4	5775.80	Ce	2.0 h	5785.00	Cr I
2.0	5765.05	Os I	1.0	5775.92	Pr II	2.5	5785.18	Tb II
22	5765.20	Eu I	7	5776.02	Gd I	6 c	5785.30	Pr II
2.5	5765.34	Ce I	2.5 c	5776.07	Nb I	0.6	5785.69	Mo I
1.0 h	5765.41	U	5	5776.12	Nd I	1.6 h	5785.82	Cr I
5	5765.64	Y I	2.5	5776.64	V I	7 h	5785.98	Ti I
5 h	5766.35	Ti I	10	5776.77	Ta I	4 h	5786.16	V I
2.0	5766.56	Ta I	11 cw	5776.83	Re I	6	5786.18	Pr II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
1.2	5786.86	Ce	5	5800.09	Nd I	6	5810.72	Ce I
10 d	5786.98	Sm II	9 l	5800.23	Ba I	10	5811.10	Ta I
	5787.15	Sm I	4	5800.27	Eu I	1.0	5811.18	Tm II
1.4	5787.22	Ce	1.6	5800.46	Mo I	1.8	5811.29	U
2.0	5787.53	Sm I	8	5800.52	Sm I	9	5811.57	Nd II
4	5787.54	Nb I	7	5800.59	Lu I	8 bl	5811.60	Sc ScO
5 h	5787.99	Cr I	3.5	5800.60	Os I	1.2	5811.83	Ce
13	5788.13	Ce I	8	5800.77	Er I	13	5812.93	Ce I
5	5788.22	Nd I	2.0	5801.24	Sm I	1.4	5813.59	Pr II
1.4 h	5788.30	Pr	1.2 h	5801.66	Sm II	1.0	5813.83	U I
8	5788.38	Sm I	1.4 l	5801.96	K I	0.6	5813.86	Mo I
1.6	5788.56	V I	3.5	5802.11	U I	5	5813.89	Nd I
2.0	5788.59	U II	2.0	5802.67	Mo I	3.0 h	5814.28	Er I
1.4	5788.92	Pr	9	5802.84	Sm I	0.8	5814.41	U I
24	5789.24	La I	5	5802.92	Gd I	6	5814.89	Sm I
0.8	5789.79	Nb I	8	5803.13	Tb I	2.0bl	5814.96	Ti TiO
28 h	5790.65	Hg I	0.8	5803.34	Rh	5	5814.98	Ru I
1.4	5790.87	Pr	0.6	5803.45	Yb I	14 d	5815.18	Pr II
15 h	5791.00	Cr I	3.0 b	5803.8	Ho HoO		5815.37	Pr I
2.5	5791.12	Er II	0.5	5803.98	Mo I	1.4 h	5815.33	Nb I
1.2	5791.32	Ce	18	5804.02	Nd II	7	5815.36	Tb I
34	5791.34	La I	2.5	5804.03	Nb I	1.6	5815.43	Th II
22	5791.38	Gd I	3.0	5804.14	Th I	1.8	5815.44	Nd I
4	5791.38	Pr II	6 hl	5804.26	Ti I	1.2	5815.47	Ce
1.8	5791.60	Re I	1.2	5804.39	Ru I	1.0	5815.52	Mo I
1.8	5791.68	Ce	10	5804.42	Ce I	0.6	5815.74	Mo I
2.0	5791.77	U	4	5804.87	W I	5	5815.85	Gd II
32	5791.85	Mo I	1.0	5805.20	U	1.0 c	5815.92	Re I
1.0	5792.72	Eu I	7	5805.68	Ba I	1.6	5816.34	Sm I
2.5	5792.77	Rh I	12	5805.78	La II	1.0 h	5816.48	Tm I
2.0	5792.96	Pr I	1.2 d	5806.07	W I	2.0	5816.51	Ta I
1.2	5793.07	W I		5806.27	W I	1.0	5816.79	U
2.5	5794.24	Nb I	2.5	5806.13	Er II	0.6	5816.84	Mn I
1.0	5794.78	Ce I	0.6	5806.19	Mo I	1.6	5817.06	V I
3.0	5795.17	Nd II	1.4	5806.25	Th II	1.2	5817.47	Hf I
8	5795.64	Tb I	1.0	5806.69	Mo I	2.5 h	5817.53	V I
1.4 h	5795.77	Mo I	2.0	5806.77	Sm I	3	5817.78	Ce II
0.8	5795.79	Rh	3.5	5806.91	Rh I	1.8	5818.32	Sm I
4	5796.06	Ce	2.5	5807.05	Gd II	5	5818.57	Pr II
1.8	5796.42	Th II	2.5 h	5807.14	V I	1.0bl	5818.58	Y YO
1.2	5796.51	W I	5 hs	5807.72	Gd I	11	5818.74	Eu II
1.0	5796.54	U	0.8	5808.06	La	0.8	5819.01	U I
6 h	5796.80	Gd I	0.6	5808.23	Mo I	5 b	5819.2	Ho HoO
17	5797.58	La II	4	5808.32	La II	5	5819.43	Nb I
13	5797.74	Zr I	0.5	5809.03	Mo I	0.6	5819.43	Yb II
6	5798.55	U	5 h	5809.22	Gd I	6 hs	5819.51	Gd I
0.4	5799.53	W I	5	5809.25	Nd I	3.0	5820.37	Nd I
2.0	5799.80	Ce	0.8	5809.50	Hf II	5	5820.40	Ce I
0.8	5799.98	Tm II	8 bl	5809.84	Sc ScO	1.6	5820.62	Nb I
1.0bl	5800.00	Y YO	3.5	5810.62	Pr II	3.5	5820.62	Pr I

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2.5	5820.68	Sm II	2.0	5834.24	Ce I	1.6	5845.26	W I
0.6	5820.69	Mo I	55	5834.31	Re I	3.0	5845.27	U
4	5820.99	Gd II	5 h	5834.86	Dy I	3.0	5845.65	Dy II
1.4 h	5821.35	Pr I	3.5	5834.90	Nb I	2.0	5845.71	Gd II
0.5	5821.84	Rh I	3.5	5835.13	Pr I	1.8	5845.77	Eu I
2.0	5821.87	Y I	1.4	5835.59	Mo I	1.6	5845.87	Hf I
3.0 h	5821.90	Ho I	5	5835.82	Er I	2.5	5845.95	Nd I
11	5821.99	La I	10	5835.84	Ce I	2.0 h	5845.98	Ce
0.6	5822.60	W I	4	5836.08	U I	0.8	5846.09	Nb I
5	5822.63	Pr	6	5836.37	Sm II	6 h	5846.30	V I
6	5822.99	Ce I	2.0	5837.15	Yb II	1.8	5846.36	Nd II
5 d	5823.37	Nd II	2.5	5837.40	Au I	6	5847.13	Pr II
1.2	5823.46	Ce	5	5837.71	U II	2.5	5847.32	Zr I
4	5823.71	Ti I	0.6 b	5838.07	Y YO	1.4	5847.59	Nd I
3.0 d	5823.72	Nd I	1.2	5838.15	Nb I	11 bl	5847.73	Sc ScO
	5824.00	Nd I	8	5838.16	Ce I	1.2	5847.77	Hf I
8	5823.72	Pr II	6 d	5838.64	Nb I	5 h	5848.05	Dy II
4	5823.83	La I	2.5	5838.78	Tm II	3.5	5848.34	Ce
4 h	5823.97	Gd I	0.8	5838.94	Th II	5	5848.38	La I
1.4	5825.20	Mo I	1.2	5838.99	W I	3.0	5848.67	Sm II
8	5825.87	Nd II	1.0	5839.05	U	1.2	5848.86	Ce
30	5826.28	Ba I	3.5	5839.38	Ce I	1.2 h	5848.86	Mo I
3.5	5826.74	Nd I	2.5	5839.47	Ho I	1.0	5848.95	La II
48	5826.79	Er I	1.2	5839.79	La I	8 bl	5849.07	Sc ScO
1.8	5827.56	La I	1.6	5839.95	Er I	5 b	5849.4	Ho HoO
1.6	5828.02	U	1.2	5839.99	Mo I	1.0	5849.68	Ta I
0.6	5828.06	Ru I	2.0	5840.12	Pt I	3.5 h	5849.73	Mo I
0.8	5828.55	Ir I	5	5840.47	Gd II	11	5850.06	Er I
6	5829.72	La I	2.0	5841.14	Er I	0.8	5850.32	V I
1.4	5830.03	Ce I	1.6	5841.84	U	6 c	5850.65	Pr II
0.5	5830.08	Co I	1.6	5842.23	Hf II	6	5851.06	Ce I
2.0	5830.13	Ce	9	5842.39	Nd II	7	5851.07	Tb I
4	5830.51	Sm I	2.5	5842.47	Nb I	3.0 h	5851.52	Mo I
1.8	5830.72	Nd I	0.7	5842.49	Os I	2.6	5851.56	W I
4 h	5830.72	V I	3.0	5842.60	Sm II	20	5851.63	Gd I
4	5830.97	Pr	3.0	5842.97	Tb I	1.0	5852.03	U
40 cw	5830.98	Eu I	1.2	5843.11	Ce I	2.5 h	5852.27	La I
6	5831.02	Sm II	1.8	5843.23	Nd	2.0	5852.34	Ti
2.0	5831.39	Ce	2.0	5843.29	U II	4	5852.63	Pr
3.0	5831.58	Rh I	4	5843.75	Ce I	0.6	5852.68	Th I
3.0 h	5831.74	Sm II	3.0	5843.76	Sm I	3.5	5853.07	Ce
10	5831.93	Ce I	1.0	5843.92	U	2.5	5853.36	Ce I
10 h	5832.01	Dy II	3.5 c	5843.94	Ta I	3.5	5853.67	Ce I
1.4	5832.27	Y I	3.5 h	5844.41	Dy II	280	5853.68	Ba II
1.6	5832.39	U	3.0 c	5844.64	Pr	2.5	5853.93	U
1.2 h	5833.21	Ru I	3.5	5844.66	Nd I	1.0 c	5854.43	Pr
1.2	5833.59	W I	2.5hs	5844.7	Cs I	1.6	5854.52	Yb I
7 h	5833.85	Dy II	0.8	5844.84	Pt I	5	5855.24	Gd II
1.2	5833.95	Er II	3.5	5845.00	Pr II	13	5855.32	Er I
2.0	5834.00	Yb II	1.8	5845.03	La I	5	5855.56	Dy II

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
6	5855.58 La I		1.2bl	5869.50 La LaO		10	5882.30 Ta I	
4	5856.08 Pr		9	5869.50 Zr I		0.6	5882.72 Mo I	
26	5856.22 Gd I		1.2	5869.95 La I		3.0	5882.78 Nd II	
1.0	5856.62 W I		1.4	5870.54 Th II		1.0	5882.92 Os I	
5	5856.92 Pr		7	5870.62 Tb I		8 c	5882.99 Ho I	
4	5856.96 Gd II		1.2	5870.85 Ce		3.5	5883.29 Nd I	
5	5857.13 Ce I		5	5870.85 Ho I		1.4	5883.66 Hf I	
22	5857.46 Ca I		3.0	5870.95 U II		3.0 c	5884.70 Pr I	
3.5	5857.52 Nd II		3.0	5871.04 Nd		7	5885.62 Zr I	
0.8	5857.76 Ni I		5	5871.06 Sm I		1.2	5885.70 Th I	
10	5857.76 Os I		8	5871.61 Ce I		2.5	5886.24 Nd I	
2.5	5858.15 Ce I		1.6	5871.67 Er II		5	5886.46 Gd I	
32	5858.27 Mo I		1.0	5871.83 Y I		3.0	5886.48 Er II	
2.0 h	5858.56 Ce II		16	5872.35 Er I		1.0	5886.95 U	
1.0	5858.83 Y YO		6	5872.98 Eu II		0.6	5887.36 Ir I	
6	5858.91 Nd I		2.0	5873.52 Er I		8 b	5887.38 Sc ScO	
1.0	5859.19 U		2.0	5873.87 Pr		3.5	5887.91 Nd I	
5	5859.39 Ce I		1.4	5873.88 Ce I		50	5888.33 Mo I	
1.4	5859.67 Th II		1.6	5874.00 La II		2.0	5888.50 Ce	
8	5859.69 Pr II		7	5874.21 Sm I		2.0 h	5888.68 Ti	
16 c	5860.28 Ho I		1.0	5874.23 W I		2000	5889.95 Na I	
2.0	5860.42 Sm II		1.6	5874.70 Nb I		1.4	5890.48 Co I	
2.5	5860.64 Os I		3.5	5874.73 La I		3.5	5891.41 Sm I	
1.4	5860.73 Er II		3.0	5874.73 Pr I		0.7	5891.45 Th I	
5	5860.73 Gd II		1.2	5875.10 Sm I		4	5891.53 Nd II	
5	5860.78 Sm I		0.8	5875.66 W I		0.7 h	5891.56 Mo I	
3.5 h	5860.79 Lu I		1.8	5875.92 Sm I		1.2	5891.61 W I	
1.8	5860.97 Eu I		1.6	5876.14 Y YO		5	5892.23 Pr II	
1.2	5861.38 Mo I		1.6	5876.59 Mo I		1.4	5892.29 Mo I	
10	5862.51 Ce I		6	5877.26 Gd II		1.4	5892.48 Ce I	
0.6	5863.43 U		19	5877.36 Ta I		4 c	5892.56 Ho I	
6	5863.71 La II		1.6	5877.63 La I		0.8	5892.88 Ni I	
3.0 h	5864.42 Ho I		0.8	5877.79 Nb I		4	5893.19 Ce I	
2.0	5864.63 W I		3.0	5877.83 Nd II		3.0 h	5893.38 Mo I	
1.0	5864.77 Eu I		1.2	5877.99 La I		2.0	5893.44 Nb I	
4	5865.06 Nd II		2.5 d	5878.08 Ce		1.2bh	5893.57 La LaO	
0.8	5866.30 Lu I		3.0	5878.11 Pr		1.6 b	5893.94 Y YO	
1.2bl	5866.42 La LaO		1.8	5878.11 Sm II		3.0	5894.06 Ir I	
38	5866.46 Ti I		4 d	5878.90 Ce I		2.0	5894.29 Pr	
3.0	5866.47 Nb I		3.0	5879.07 Pr I		5	5894.85 La I	
1.2	5866.61 Ta I		7	5879.25 Pr II		3.0	5895.16 Sm I	
4	5867.08 Nd I		3.0 b	5879.6 Ho HoO		1.0	5895.31 Eu I	
9	5867.79 Sm I		28	5879.80 Zr I		2.0	5895.33 U	
7 h	5868.10 Dy II		1.6	5879.96 Y I		18	5895.65 Tm I	
4	5868.27 Zr I		1.2	5880.22 W I		1000	5895.92 Na I	
6	5868.61 Sm I		6	5880.31 Ti I		1.2bh	5896.67 La LaO	
0.8	5868.76 Mo I		5	5880.64 La II		0.5	5897.23 Yb II	
7	5868.83 Pr II		13	5881.14 Er I		6	5897.39 Sm II	
3.5	5868.90 Nd I		0.6	5881.53 Mo I		4	5897.62 Gd II	
3.0	5869.33 Mo I		0.8	5882.30 Ir I		1.2	5897.72 Ce	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
1.4	5898.10	Ce	0.6	5908.95	Os I	1.0	5922.79	Nd I
1.2	5898.78	Mo I	3.0	5909.04	Sm I	3.0	5923.34	Sm I
	5898.82	Mo I	5	5909.25	Er I	0.6 h	5923.79	Mo I
1.8	5898.78	U I	6	5909.86	Ce I	1.2bh	5923.97	La LaO
3.5	5898.84	Tb I	4	5909.87	Nd II	2.5	5924.05	Ce I
7	5898.96	Sm I	0.8	5909.94	Eu I	2.5	5924.54	Dy II
22	5899.32	Ti I	1.6	5910.10	Tb I	3.0	5924.57	V I
2.5	5899.48	Tm I	6	5910.13	Ce I	3.0	5924.66	Sm I
2.0	5899.49	Nd I	1.2	5910.83	Sm I	2.0	5924.87	Ce
1.2	5899.70	Ce	16	5911.45	Gd II	11	5925.13	Zr I
2.5	5900.43	Nd II	0.5	5912.12	Mo I	0.8	5925.30	Eu I
9 cw	5900.62	Nb I	1.6 b	5912.19	Y YO	2.0 h	5925.47	U I
1.2	5900.67	Ce I	0.6	5912.59	Tm I	1.6	5925.89	Th II
0.8	5900.75	La I	4	5912.61	Sm I	1.2	5925.90	Ta I
4	5901.09	Zr I	5	5912.91	Ce I	6	5926.30	Ce I
1.2	5901.23	W	6	5913.55	Gd II	2.5 h	5926.36	Mo I
4	5901.32	Ce I	3.0	5913.56	Sm I	1.0	5926.47	Hf I
2.5	5901.47	Mo I	3.5	5914.39	Th II	1.8	5926.52	Eu I
1.8	5901.58	Tm I	1.0	5914.40	Nd I	1.6	5926.87	Ru I
7	5901.91	Ta I	1.4	5914.68	Th I	1.4	5927.41	Nb I
1.2	5901.96	La II	1.2	5914.84	Ce I	1.2	5927.71	La II
3.0	5902.09	Er II	5	5915.17	Dy II	7 bl	5928.10	Sc ScO
2.5	5902.40	Tb I	1.0	5915.31	Pr I	9	5928.34	Ce I
2.0	5902.50	U	20	5915.40	U I	1.6	5928.49	La I
4	5902.60	Sm I	1.4	5915.54	Co I	1.2	5928.58	W
3.5	5902.66	W I	2.0	5915.56	Sm I	10 h	5928.88	Mo I
2.5	5902.96	Y I	5	5915.74	Eu I	1.8	5929.33	U I
1.8	5902.97	Eu I	1.0	5915.98	Pr I	2.0	5929.50	Ce
3.5	5903.13	Pr	2.0	5916.36	Sm I	3.0	5929.84	Ce I
5	5903.33	Ti I	2.0	5916.46	Er I	8	5930.29	Gd I
4	5903.50	Sm II	2.5	5916.51	Ta I	24	5930.62	La I
2.0 c	5903.80	Nb I	5	5916.77	Gd I		5930.68	La I
1.0	5903.98	Os I	3.5	5917.63	La I	1.2	5930.62	Ta I
5	5904.07	Gd II	4 bl	5918.04	Sc ScO	3.5	5930.67	Pr I
2.5	5904.29	Ho I	0.8	5918.54	Rh I	1.8	5931.05	Ta I
1.2	5904.30	La I	11	5918.55	Ti I	1.6 b	5931.10	Y YO
4	5904.45	Pr II	7	5918.95	Ta I	1.6	5931.68	Ta I
10	5904.56	Gd I	3.5	5919.11	Sc I	0.8	5931.72	Tm I
3.5	5904.71	Tb I	3.0	5919.33	Sm II	2.5	5932.16	Ce I
2.5	5906.01	Ce I	4	5919.34	Ru I	3.5	5932.18	Sm I
2.5	5906.05	Sm I	1.0	5919.86	Re I	2.0	5932.38	Ru I
6	5906.07	Er I	5	5920.44	Ce I	1.4	5932.44	U II
3.0	5906.65	Nd II	3.5	5920.76	Pr I	3.5	5932.90	Sm II
1.0	5906.84	Os I	7 c	5920.78	Tb I	4	5933.50	Er I
0.6	5907.31	Rh I	1.2bh	5920.84	La LaO	1.8	5933.58	Ce
1.2	5907.49	Ce	3.0	5921.01	Sm I	4	5933.69	Hf I
5	5907.64	Ba I	3.0	5921.22	Nd I	3.5 c	5933.71	Ho I
1.2	5908.38	Yb II	6	5921.45	Ru I	1.4	5933.85	U I
2.5bl	5908.61	Zr ZrO	8	5921.76	Ho I	2.0 c	5934.16	Nb I
3.5	5908.67	Pr	14	5922.12	Ti I	10 d	5934.44	Ce

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
0.9	5934.46	U	2.5	5947.64	Ce I	1.2	5963.36	Ce I
3.0	5934.75	Nd II	8 cw	5948.03	Ho I	6	5963.76	Eu I
8	5935.20	Zr I	1.4 h	5948.30	La II	6 l	5964.50	Dy I
5	5935.24	La I	1.2	5948.57	U I	1.8	5964.64	Ce
0.7	5935.39	Co I	1.6	5949.64	Nd I	1.2	5965.30	La I
1.4	5935.54	Ta I	2.0 c	5949.79	Pr I	0.6	5965.57	Mo I
2.0	5935.90	Tm I	1.6	5950.02	Y I	9	5965.71	Sm II
4	5936.22	La II	1.0	5950.21	Re I	19	5965.84	Ti I
1.4	5936.31	Pr	2.5	5950.61	Ce I	5	5965.86	W I
0.6	5936.65	Ru I	0.6	5951.15	Ru I	22	5966.07	Eu II
8	5936.84	Gd I	2.5	5951.17	Tb I	8	5966.26	Ce I
1.6	5937.09	Tb I	1.2	5951.21	Ce I	32 cw	5967.10	Eu I
1.6	5937.20	Er II	5	5951.28	Pr II	8	5967.34	Tb II
6	5937.71	Gd I	5	5951.60	Gd II	10	5967.84	Pr II
10	5937.72	Ce I	2.0	5951.78	Ta I	7 bl	5968.25	Sc ScO
7	5937.82	Ti I	1.6	5951.78	Tb I	1.0 h	5968.43	Eu I
1.0	5937.91	Mo I	1.8	5951.78	Pr	0.5	5968.48	Mo I
2.0	5938.44	Ce I	1.8	5952.05	U II	6	5968.70	Er I
1.4	5938.83	Th I	28	5953.17	Ti I	5 h	5968.82	Sm II
5	5938.90	Sm II	1.8	5953.49	Eu I	4	5969.19	Sc I
6 bl	5939.08	Y YO	1.8	5953.84	Eu II	1.8	5969.49	Sm I
5 c	5939.38	Tb I	1.2	5953.97	W I	1.8 h	5969.77	Re I
10	5939.76	Ta I	2.0	5954.28	Eu I	2.0 h	5970.10	Sr I
14	5939.91	Pr II	9	5955.35	Zr I	1.0	5971.09	La II
3.5	5940.17	Tb I	3.5 h	5955.82	Sm II	10	5971.28	Tm I
6	5940.73	Pr II	3.0	5955.87	Nd I	5	5971.50	U I
1.0	5940.83	La I	5	5955.98	Ho I	2.0	5971.69	Eu I
25	5940.85	Ce I	1.2	5956.18	W I	50	5971.70	Ba I
5 h	5940.95	Gd	5 b	5956.41	Y YO	85 bl	5972.04	Y YO
0.6	5941.46	Rh I	5	5956.48	Gd II	3.0	5972.10	Ce
30	5941.54	Ce	8	5956.62	Pr II	2.5	5972.52	W I
2.0	5941.65	Pr I	3.5	5956.76	Sm I	11	5972.75	Eu I
11	5941.76	Ti I	2.5 d	5956.84	Ce	8	5972.76	Ho I
3.0	5942.33	Sm I	1.8	5956.86	U I	1.2	5972.80	Ce I
3.0	5942.66	Ce I	3.0	5957.52	Sm II	1.6 h	5973.38	Ru I
3.0	5942.72	Eu I	2.0	5957.70	Nb I	10	5973.52	Ho I
0.9	5942.77	U I	1.2	5959.31	Pr I	3.5	5973.53	La II
5 h	5942.78	Gd	3.5	5959.70	Ce	2.5	5973.67	Th I
3.5	5943.22	Nd II	3.5	5960.09	Sm I	0.6	5974.17	Ru I
6	5943.24	Re I	1.4	5960.13	Ta I	0.9	5974.26	Mo I
19	5944.02	Ta I	2.0	5960.59	La I	5	5974.28	Hf I
0.8	5944.66	Th I	2.5 d	5960.81	Ce	15	5974.50	Dy I
3.0	5944.88	Ce I	2.5	5960.82	W	1.6	5974.72	Hf I
3.0	5945.72	Y I	2.0	5961.00	Tb II	2.0	5975.03	Tm I
9	5945.81	Dy I	1.6	5961.16	Nd I	2.5	5975.06	Th I
2.5	5946.36	Er I	4	5961.49	Sc I	3.0	5975.50	Er I
3.5	5946.37	Sm I	1.8	5962.21	Pr I	1.4 h	5975.75	La I
0.6	5946.49	Co I	1.2	5962.60	La I	8	5975.87	Ce II
3.0	5947.20	Pr	2.5	5963.02	Pr I	4	5975.98	Ce I
5	5947.58	W I	3.5	5963.22	Sm II	9	5976.32	U I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
1.2 c	5976.96	Pr I	0.6	5990.01	Mo I	1.8	6003.26	Dy I
8	5977.25	Gd I	1.2	5991.03	Th I	50 bl	6003.60	Y YO
2.5bl	5977.80	Zr ZrO	0.8	5991.19	Rh I	1.2	6003.66	Ce
26	5978.56	Ti I	1.2	5991.26	Pr	3.0	6004.18	Sm I
4	5978.66	Hf I	0.6	5991.35	Mo I	4	6004.36	Eu I
1.2	5978.88	Pr I	2.5	5991.51	Yb II	120	6004.52	Lu I
1.8	5978.89	W I	2.0	5991.88	Co I	5	6004.57	Gd II
2.0	5978.91	V I	1.2	5992.36	La I	8	6004.65	Y
3.5	5979.38	Sm I	5	5992.66	Ce I	1.8	6004.83	U
2.0	5979.40	Ce I	16	5992.83	Eu I	3.0	6005.33	Ho I
1.6 c	5979.83	Tb I	1.6	5992.96	Hf I	1.0 h	6005.61	Eu I
1.0	5980.47	Eu I	2.5	5993.65	Ru I	3.0 h	6005.75	Dy II
1.4	5980.78	V I	1.8 h	5993.85	Sm	6	6005.86	Ce I
1.2	5981.20	Ce	2.0	5994.16	Th I	1.6	6006.21	Ce I
6	5981.21	Pr II	3.5	5994.64	Sm II	8	6006.35	Pr II
0.6	5981.36	Os I	3.5	5994.76	Nd I	0.7 h	6006.36	Co I
2.5	5981.43	Ho I	1.2 c	5994.92	Pr	3.0 h	6006.54	Dy II
3.5	5981.86	Y I	4.0	5995.09	Sm I	4	6006.80	Er II
2.0	5982.35	La I	8 d	5995.35	Ce II	6	6006.81	Ce I
26 c	5982.90	Ho I	1.4	5995.37	Zr I	3.0 h	6006.97	Dy
1.0	5982.93	Mo I	1.8 h	5995.73	Re I	1.8	6007.07	Th I
1.8	5983.14	Eu I	6	5996.00	Os I	2.0	6007.36	Ce
7	5983.22	Nb I	1.0	5996.05	Pr	5	6007.36	La I
1.0	5983.22	Os I	3.0	5996.47	Nd I	0.7 h	6007.67	Co I
11	5983.60	Rh I	2.0	5997.05	Ce II	5	6007.67	Nd I
1.8	5983.78	Eu I	50	5997.09	Ba I	1.6 h	6007.95	Er II
1.8	5983.84	W I	12	5997.13	Lu I	1.2	6008.61	Pr I
60 cw	5983.9	Lu II	15 c	5997.23	Ta I	5	6008.71	Gd I
0.8 h	5984.08	Co I	4	5997.31	U I	2.5	6008.76	Er II
8	5984.23	Zr I	4 cw	5997.93	Nb I	1.8	6008.87	U
5	5984.29	Sm I	1.4	5997.96	U I	4.0	6008.92	Dy I
3.0	5984.86	Dy I	32	5999.04	Ti I	1.2	6009.04	W I
0.8	5984.87	Tm I	8	5999.08	Gd I	8	6009.19	Y I
1.2	5985.99	Dy I	2.0	5999.41	U I	1.6	6009.30	Nd II
3.0	5986.08	Nb I	6	5999.68	Ti I	2.0 h	6009.89	Ta I
2.5	5986.10	U I	1.2	6000.18	Ce I	0.9	6010.18	Th I
3.5	5986.14	Pr I	1.8	6000.20	U	8 hs	6010.33	Cs I
4 c	5987.15	Pr I	1.0	6000.67	Co I	1.2	6010.65	Tb II
70 bl	5987.64	Y YO	1.8	6000.86	Dy I	8	6010.80	Dy I
10 h	5988.02	Gd I	6	6000.96	Gd I	1.8	6010.86	U I
2.5	5988.17	Mo I	4	6001.05	Zr I	3.5	6011.22	Sm II
10	5988.42	Sc I	0.6	6001.22	Th I	4 h	6012.20	Eu I
18	5988.57	Dy I	7 h	6001.87	Gd I	7	6012.56	Eu I
1.2	5988.67	Ru I	6	6001.89	Ce	2.0	6012.73	Ti
7	5989.07	Th II	0.8hl	6001.93	Pb I	5	6012.81	W I
1.0	5989.32	Yb I	3.0	6001.94	Sm I	8	6013.42	Ce I
3.5	5989.34	Nd II	6	6002.04	Ho I	12	6013.50	Mn I
5	5989.38	Ce I	2.0	6002.31	V I	1.8	6014.07	U
1.0	5989.47	Mo I	2.6	6002.45	Pr	6	6014.83	Er I
1.0	5989.99	Re I	4	6002.63	V I	2.5	6015.43	Th II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
4	6015.58	Eu I		6027.52	Sm I	8	6047.25	Ta I
4	6015.76	Er II	1.0	6027.27	Mo I	6	6047.39	Ce I
1.8	6015.79	Os I	2.0	6028.13	U	1.2	6047.83	Mo I
2.0	6015.90	Ta I	1.8	6028.35	W I	2.5	6048.13	Er II
2.0	6016.12	V I	11	6029.00	Eu I	1.2	6048.72	Nb I
5	6016.49	Pr II	2.5	6029.75	Nb I	0.7 h	6049.10	Co I
2.5	6016.57	Ce I	80	6030.66	Mo I	8	6049.24	Zr I
17	6016.64	Mn I	3.0	6031.00	Dy I	3.0	6049.26	Pr I
0.9	6016.73	U I	1.2	6031.25	Ce I	28	6049.51	Eu II
3.0 c	6016.79	Hf I	4	6031.27	Nd II	1.2	6049.92	W I
1.6	6016.80	Sm I	2.5	6031.84	Nb I	2.5	6050.03	Pr
18 bl	6017.07	Sc ScO	2.5	6032.14	Er II	0.8	6050.48	U I
1.2	6017.16	La I	7	6032.61	Zr I	0.8	6050.67	U I
3.0	6017.27	Dy I	2.5	6033.23	Sm II	3.0	6050.71	Ho I
2.5	6017.39	Sm II	3.0	6033.29	Nd I	1.0	6050.88	Pr I
2.5	6017.39	U II	2.5	6033.58	Ce II	5	6051.74	U
1.8	6017.57	U I	1.4 h	6034.09	Cs I	2.0	6051.80	Ce II
13	6017.80	Pr II	3.5	6034.20	Ce II	0.6	6052.90	Yb II
28	6018.15	Eu I	5	6034.24	Nd II	2.0	6053.64	Ta I
1.0	6018.79	Ce I	2.5	6034.59	Ce	28 bl	6053.81	Y YO
1.0	6019.00	Th II	3.5	6035.49	Ce II	1.2 h	6053.88	Sm I
1.4	6019.19	U I	0.6	6035.54	U	1.6	6054.17	Hf I
1.6	6019.24	Tb II	70 bl	6036.17	Sc ScO	0.6	6054.56	Yb I
50	6019.47	Ba I	34 bl	6036.60	Y YO	0.6	6054.63	Os I
42 bl	6019.87	Y YO	1.4	6037.70	Th I	1.2	6054.81	Mo I
2.5 c	6019.90	Pr I	4	6038.59	La I	5	6054.84	Er I
1.0	6020.60	Ce I	1.8	6038.97	Ho I	38	6055.03	Lu I
8	6020.72	Ta I	3.0	6038.97	Tb I	12	6055.13	Pr I
1.4	6021.04	Th I	3.0	6039.38	Tb I	1.4	6056.65	Nb I
1.8 b	6021.12	Hf HfO	1.8	6039.60	U I	1.4	6056.80	U I
5	6021.13	Gd I	32	6039.73	V I	1.4	6057.07	U I
4	6021.43	Ho I	4	6041.40	Sm I	9	6057.36	Eu I
3.5	6021.54	W I	1.0	6041.55	La I	2.5	6057.49	Ce I
24	6021.80	Mn I	3.0 h	6041.66	Lu I	3.5	6057.99	Ce I
8	6022.56	Er I	3.0bl	6042.49	Dy	7	6058.14	V I
4	6023.15	Eu I	2.5	6042.84	Sm I	3.0	6058.16	Dy I
8	6023.41	Y I	3.0	6042.87	Pr	1.6	6059.73	U II
0.8	6024.06	Fe I	1.6 b	6043.19	Hf HfO	5	6060.31	Ho I
12	6024.19	Ce I	1.8	6043.33	W I	8	6061.26	Er I
2.5	6025.36	Zr I	12	6043.39	Ce II	1.6	6061.83	Tb I
1.4	6025.41	V I	2.0	6044.42	Th II	1.6	6062.30	U I
1.4	6025.45	Tm I	4	6044.66	Eu I	11	6062.84	Zr I
2.0	6025.49	Mo I	7	6045.00	Sm I	110	6063.12	Ba I
1.0	6025.54	Nd I	6	6045.39	Sm I	55 bl	6064.31	Sc ScO
13	6025.72	Pr II	20	6045.39	Ta I	10	6064.63	Ti I
0.6	6026.04	Pt I	3.0	6045.43	Ce	1.2	6065.09	W I
0.6	6026.10	Ir I	2.5	6045.50	Nb I	1.2	6065.49	Fe I
7	6026.18	Sc I	2.5	6045.65	Er II	6	6066.03	Nd I
1.6	6027.16	Ce I	14	6045.85	Zr I	1.0	6066.49	Th II
3.5	6027.16	Sm I	5	6046.68	Pr II	2.5	6066.71	Ce I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
1.0	6067.14	La II	17	6088.24	Dy I	6	6108.48	La I
4	6067.23	U	1.6	6088.62	Sm I	3.0	6108.74	Ce II
1.2	6067.24	Pr	4	6088.92	Ce	1.6	6109.06	Pr I
1.4	6067.26	V I	1.4	6089.19	U I	42 bl	6109.93	Sc ScO
1.6	6067.78	Sm II	14 bl	6089.35	Y YO	6	6110.66	Sm II
0.8	6067.78	Tm II	90	6090.22	V I	1.6	6110.67	Ir I
1.0	6067.83	Ir I	1.8	6090.37	Pr	170	6110.78	Ba I
1.0	6068.63	Ce	2.5	6090.82	Ta I	0.8	6110.91	U
3.5	6068.68	La I	11	6091.17	Ti I	20	6111.67	V I
6	6069.47	Ce I	5 h	6091.40	Sm I	1.2	6111.68	W I
7	6070.06	Sm I	1.4	6092.06	Ta I	3.5	6111.72	La I
3.0	6071.70	Nd I	4	6092.81	Ti I	1.8 h	6111.95	Ce
4	6072.00	Ce I	2.5	6093.04	Pr	3.5	6112.83	Th II
1.0	6072.05	La I	1.4	6093.13	Co I	1.6 h	6112.98	Sm I
50 bl	6072.65	Sc ScO	3.5	6093.20	Ce I	40	6114.07	Gd I
9 bl	6072.78	Y YO	1.6	6093.99	Tb II	3.0	6114.22	Re I
2.5	6073.09	Th II	1.6	6096.35	Pr I	6	6114.40	Pr II
3.5	6073.97	Nd I	2.0	6096.78	Sm I	2.5	6114.58	Sm II
6	6075.58	Eu I	11 bl	6096.78	Y YO	3.0	6114.73	Sm I
1.6 h	6075.72	Sm I	5	6098.34	Ce II	9 bl	6114.73	Y YO
7	6076.44	Er II	6	6098.67	Hf I	1.2	6115.55	W I
3.5	6076.60	Ce	4 h	6098.67	Ti I	42 bl	6115.97	Sc ScO
1.8	6077.14	Ce I	2.0	6099.08	Th II	4	6116.00	Er I
8	6077.29	U I	16	6099.35	Eu I	0.5	6116.15	Rh I
2.0	6077.38	Eu I	1.2	6099.79	Ce I	1.4	6116.77	Ru I
1.6	6077.84	Tb II	2.0 h	6099.90	Sm I	1.0	6116.98	Co I
70 bl	6079.30	Sc ScO	3.0	6100.38	La II	2.0 c	6118.02	Pr I
1.2	6079.58	Mo I	8	6101.58	Ta I	1.6	6118.55	Ce
1.8	6080.37	Ce	1.6	6101.75	Nd I	8	6118.78	Eu I
5	6080.65	Gd II	1.6	6101.77	U I	1.8	6118.89	Ce I
0.6	6081.27	Mo I	2.5	6101.87	Mo I	42	6119.52	V I
1.8	6081.28	Ce I	36 bl	6101.87	Sc ScO	1.0	6119.74	Ce I
34	6081.44	V I	2.5	6101.96	Sm	2.5	6120.55	Th II
2.0	6081.48	W I	0.9	6102.60	Th I	4	6120.83	Zr I
13	6081.79	Ho I	34	6102.72	Ca I	3.5 h	6121.01	Ti I
2.0	6082.44	Co I	3.0	6102.72	Rh I	14	6121.91	Zr I
16	6083.84	Eu I	3.0	6103.37	Sm	95	6122.22	Ca I
6	6084.12	Sm I	320	6103.64	Li I	2.0 c	6122.24	Pr I
1.6	6084.34	Tb II	2.5	6104.29	Tb II	1.0	6122.65	Co I
1.2 h	6084.89	La I	2.5	6104.57	Th II	2.5	6122.75	Sm I
4	6085.04	Dy I	1.6	6105.20	Er II	3.0	6123.60	Sm II
11	6085.23	Ti I	1.4	6106.06	Tb II	5	6123.67	Ce I
1.0	6085.26	Th II	2.0	6106.76	Pr	1.0	6124.31	Ce I
1.2	6085.85	Pr	2.0	6106.98	V I	4	6124.67	Eu I
2.5	6086.15	Pr	1.2	6107.27	La I	7	6124.84	Zr I
0.8	6086.65	Co I	1.4	6107.71	Nb I	2.0	6124.88	Sm II
2.5	6087.25	Th II	9 bl	6107.82	Y YO	4	6125.32	Er I
2.5	6087.34	U II	0.8	6108.12	Ni I	6	6126.09	La II
6	6087.51	Pr II	4	6108.15	Eu I	11	6126.22	Ti I
3.5	6088.00	Y I	1.6	6108.41	Nd II	2.0	6126.33	Sm I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
2.0	6127.05	La I	1.2	6143.94	W I	3.0	6160.42	Sm II
3.0	6127.15	Dy I	1.8	6144.53	Os I	6 l	6160.76	Na I
5 bl	6127.38	Y YO	5	6144.56	Ta I	17	6161.19	Pr II
55	6127.44	Zr I	1.0	6145.30	La I	3.0	6161.29	Ca I
1.4	6127.77	U I	3.5 c	6145.81	Re I	140	6162.17	Ca I
0.7	6128.06	Rh I	3.0	6146.22	Ti I	2.0	6162.17	Ce I
2.0	6128.27	W I	2.5	6146.42	Ce I	3.0bl	6162.23	Ti TiO
1.4	6128.34	V I	1.4	6146.53	La II	3.0 h	6163.76	Ca I
6	6129.56	La II	5	6146.82	Re I	2.5	6164.32	Nb I
2.5	6129.72	U I	2.0	6147.85	Ce I	0.7	6164.50	U I
1.0	6130.13	Ce	2.5	6148.13	Nb I	1.6	6164.51	Sm II
1.6	6130.62	Sm I	6	6148.25	Pr I	1.4	6164.77	U
0.6	6130.63	Mo I	75 bl	6148.36	Y YO	55 bl	6165.08	Y YO
1.2	6131.54	Tm I	20 b	6148.70	Sc ScO	1.6	6165.26	Pr I
4 d	6132.00	Ce	4	6149.10	Sm II	2.0	6165.47	Ce
95 bl	6132.06	Y YO	3.0	6149.28	Nd I	6	6165.70	La I
1.8	6132.61	U	1.4	6149.30	Er II	2.5	6165.84	Sm I
2.5 d	6133.47	Nd I, II	1.0	6149.58	Ce	24	6165.95	Pr II
8 cw	6133.60	Ho I	2.0	6149.74	Ti I	6 h	6166.44	Ca I
3.0	6133.63	Dy I	13	6150.15	V I	2.5	6166.67	Nd II
4	6134.39	La I	8	6151.72	Y YO	1.6 h	6168.33	Sm II
1.4	6134.39	Tb II	2.5	6151.73	Ce I	13	6168.43	Dy I
28	6134.55	Zr I	1.2	6151.99	Th I	7	6169.05	Ca I
8	6135.04	Y I	0.8	6152.25	U I	14 h	6169.56	Ca I
20	6135.38	V I	2.5	6152.54	Ta I	5	6169.82	Th I
2.0	6135.52	Ce	3.5	6152.58	Yb II	3.5	6170.05	Er II
3.0	6135.85	Sm I	1.8	6153.73	W I	6	6170.36	V I
3.0	6136.62	Fe I	17 b	6153.93	Sc ScO	1.2	6170.46	Ta I
1.4	6137.00	Tb II	3.0 l	6154.23	Na I	4	6170.49	Nd II
1.0	6137.23	Ce	10	6154.50	Ta I	3.5	6171.85	U I
2.0	6137.70	Fe I	1.8	6154.86	W I	1.2	6171.88	Tb
2.5	6138.05	Sm I	3.0	6155.06	Nd I	2.5	6172.73	La II
1.8	6138.38	Ti I	2.5	6155.61	Zr I	1.6	6172.87	Ce
10	6138.43	Y I	1.6	6156.16	Nd I	22	6173.05	Eu II
0.8	6138.54	U	1.4 c	6156.29	Tb I	2.5	6173.95	Sm I
2.5	6139.03	Ce I	4	6156.38	Ho I	2.5	6174.45	Sm I
2.5	6139.33	Sm I	3.0	6156.58	Ho I	2.5	6174.96	Sm II
2.0	6140.07	Ta I	2.0	6156.90	Sm II	2.0	6175.29	Ce
8	6140.46	Zr I	2.0 h	6157.55	Sm II	1.0	6175.30	Tm I
3.0	6140.60	Sm I	6	6157.71	Zr I	3.0	6175.38	U I
1.0	6140.71	Lu I	2.0	6157.80	Pr	0.8	6176.81	Ni I
3.0	6141.51	Pr II	4	6157.83	Nd II	5	6178.59	Nd I
2000	6141.72	Ba II	1.0	6158.03	Os I	7	6178.76	Eu I
2.0	6142.51	Nb I	3.0	6158.32	Dy I	2.5	6179.41	Sm I
1.6	6142.91	Ce I	3.0	6158.84	Ta I	3.0 h	6179.82	Sm II
1.8 h	6142.98	La I	1.2	6159.09	Pr II	5	6180.42	Gd II
2.5	6143.09	Sm I	6 h	6159.56	Sm I	2.5	6181.05	Sm II
36	6143.20	Zr I	2.0	6159.82	Ce	0.7	6181.37	U II
4	6143.36	Ce II	13	6159.94	Lu II	1.0	6181.42	Tm II
1.6	6143.59	Sm I	2.0	6160.20	Zr I	38 bl	6182.23	Y YO

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
5	6182.34	Pr II	1.2	6199.99	Rh I	1.0	6218.4	Tb II
4	6182.62	Th I	1.0	6200.43	Th II	7 h	6220.49	Ti I
10 bl	6182.68	Gd GdO	3.0	6200.79	Pr II	10 bl	6220.93	Gd GdO
4 h	6182.89	Sm II	10 bl	6200.86	Gd GdO	40	6221.01	Er
3.0	6183.20	Er II	2.5	6201.13	Sm I	6 h	6221.41	Ti I
3.0	6183.91	Nd II	2.0	6201.74	Nd II	180	6221.87	Lu II
1.0	6184.77	Th I	1.8	6203.24	Re I	3.5	6221.96	Nb I
6	6185.13	Hf I	1.0	6203.50	Th I	1.4	6222.25	Tb II
3.5	6186.15	Ti I	1.2	6203.51	La II	20	6222.59	Y I
4	6186.16	Ce I	1.8	6203.51	W I	1.0	6223.25	Ce I
0.7	6186.89	Rh I	3.5	6203.86	Sm I	5	6223.39	Nd I
1.0	6186.92	Ce	1.2	6205.65	Pr	9	6224.50	V I
1.6	6187.91	Ce I	2.5	6206.31	Rb I	1.0	6224.53	Th I
1.2	6187.98	Pr I	3.0	6206.87	Sm I	2.0	6225.20	Ru I
3.0	6188.00	Sm II	1.4	6207.13	Sm I	1.4	6225.48	Sm
2.0	6188.09	La II	1.6	6207.22	Th I	1.0	6225.95	Tb II
17 b	6188.09	Sc ScO	1.0 h	6207.60	Eu I	3.0	6226.50	Nd I
1.6	6188.12	Th I	1.4	6208.01	Nd	14 bl	6226.51	Zr ZrO
17 cw	6188.13	Eu I	3.0	6208.24	Nd I	2.5	6226.70	Sm I
1.4	6189.00	Co I	2.0	6208.37	Ta I	3.0	6227.70	Os I
1.6	6189.35	V I	8	6208.65	Ho I	3.0	6228.14	Lu II
3.0	6189.40	Zr I	4	6208.99	Ce	1.0	6228.23	Ce I
1.2	6189.66	Ta I	1.0	6209.56	Ce I	5	6229.00	Ce I
0.8	6191.18	Ni I	1.2	6210.59	Pr I	3.0cw	6229.42	Re I
2.0	6191.56	Fe I	1.0	6210.68	Nd II	1.0	6230.51	Eu I
6	6191.68	Ho I	70	6210.68	Sc I	2.0	6230.73	Fe I
80	6191.73	Y I	3.5	6210.70	Hf I	30	6230.74	V I
1.0	6191.89	Th I	1.0	6211.06	Ce I	4	6230.90	Er I
4	6192.64	Sm	10 bl	6211.71	Gd GdO	0.8	6230.97	Co I
17 b	6192.90	Sc ScO	1.0 h	6212.50	Ce	5 bl	6231.62	Gd GdO
5	6192.96	Zr I	2.0	6212.73	Pr I	2.5	6232.45	Ce II
1.2	6193.11	Ta I	12 hs	6212.87	Cs I	1.0	6232.98	Th II
1.2	6193.64	Tb II	7	6213.05	Zr I	7	6233.20	V I
2.0	6193.86	Th II	1.4	6213.06	Nb I	2.5	6233.51	La I
2.5	6194.39	Sm I	9	6213.87	V I	6 h	6233.73	Eu I
1.2	6194.52	Tb II	8	6214.69	Zr I	2.0	6234.17	Ho I
9	6195.07	Eu I	9 h	6215.28	Ti I	1.4	6234.30	U I
1.2 c	6195.14	Tb II	1.4	6215.37	U I	2.0 h	6234.85	Th I
1.6	6195.25	Ce I	32	6216.37	V I	2.5 h	6234.86	La I
2.0	6195.55	Ce I	1.4	6216.69	Nd I	7	6235.36	Lu II
2.5	6196.23	Dy II	1.8	6216.82	Hf I	1.4 h	6236.17	La I
3.0	6197.46	Pr	1.2	6216.84	Ce	18 bl	6236.72	Y YO
0.6	6197.66	Mo I	2.5	6217.17	Sm	1.0 h	6236.74	La I
2.0	6198.05	Ce	0.8	6217.27	Cs I	1.8 h	6236.83	Pr I
1.4	6198.14	Sm II	1.2	6217.89	Mo I	3.0	6237.46	Ce I
0.8	6198.24	Th I	30 bl	6217.96	Y YO	4	6237.66	Sm II
32	6199.19	V I	2.5	6217.97	Re I	2.5	6238.30	Sm I
2.0	6199.42	Ru I	1.6	6218.08	Pr I	2.5	6238.50	Nd II
14	6199.66	Lu II	1.0	6218.20	La I	3.0	6238.58	Hf I
40 bl	6199.82	Y YO	2.0 h	6218.31	V I	1.4 h	6238.59	La I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
1.4	6238.70 Ce I		0.7 h	6257.58 Co I		1.0	6273.76 La II	
10	6239.41 Sc I		1.4	6257.99 Ce		4	6274.13 Th II	
36	6239.78 Sc I		36	6258.10 Ti I		12	6274.65 V I	
4	6240.13 V I		6	6258.57 V I		2.0 c	6274.74 Pr	
1.8 h	6241.11 Pr I		1.0 h	6258.60 Th II		3.5	6274.80 Yb II	
7 bl	6241.66 Gd GdO		36	6258.70 Ti I		1.0	6274.94 Os I	
0.6	6241.70 Os I		3.0	6258.73 Nd II		4	6274.96 Er I	
1.4 d	6241.91 Ce I		28	6258.96 Sc I		8 bl	6275.01 Y YO	
14	6242.34 Lu II		34	6259.09 Dy I		6	6276.31 Sc I	
12	6242.81 V I		3.5 d	6260.02 Re I		1.6	6276.46 Ce I	
1.4	6242.91 Ce			6260.24 Re I		0.4	6276.66 Rh I	
50	6243.10 V I		4	6260.38 Dy I		0.9	6277.23 Th II	
3.5cw	6243.24 Re I		1.0	6260.77 Nb I		2.5	6277.29 Nd II	
4	6244.08 Nd I		4 b	6261.05 Zr ZrO		0.7	6277.46 Rh I	
3.5 h	6244.21 Sm II		1.8	6261.06 Th II		6	6278.18 Au I	
4	6244.34 Pr II		28	6261.10 Ti I		4	6278.34 Ta I	
14	6245.63 Sc II		4	6261.22 V I		3.5	6278.68 Pr II	
0.7	6246.34 Fe I		1.8	6261.42 Th I		1.8	6278.76 Re I	
1.4	6246.53 U I		16	6262.25 Eu I		2.5	6279.16 Th II	
6	6246.76 Sm II		7	6262.25 Sc I		1.4	6279.49 Sm	
1.8	6246.97 Yb II		20 d	6262.30 La II		1.0	6279.64 U II	
2.0	6248.11 Sm I		3.5	6262.54 Pr II		5	6279.76 Sc II	
1.4	6248.28 Nd II		6	6262.56 Er I		2.5	6280.20 U II	
1.4 h	6248.80 Lu I		5 bl	6262.64 Gd GdO		10	6281.31 Pr II	
4	6248.95 Hf II		2.0	6263.23 Nd II		5	6281.33 Ta I	
1.0	6249.51 Co I		1.6	6264.26 Ce		2.0	6282.00 Nd I	
3.0	6249.79 Ta I		0.6	6264.27 Mo I		1.2 h	6282.33 V I	
55	6249.93 La I		1.6	6264.60 Pr		2.0	6282.63 Co I	
12	6249.96 Sc I		0.5	6265.14 Fe I		0.7	6284.49 Ru I	
1.0	6250.43 Nd II		1.0	6265.88 Mo I		14	6285.16 V I	
3.5	6250.47 Eu I		7	6266.02 La I		1.4	6285.28 Th II	
3	6251.05 Y I		0.9	6266.17 Th II		3.0	6285.79 Nd I	
2.0 c	6251.76 Nb I		6	6266.32 V I		2.5	6285.90 W I	
20	6251.82 V I		3.5	6266.95 Eu I		1.0 h	6285.95 Eu I	
5 b	6252.12 Gd GdO		3.0	6267.06 Zr I		1.6 h	6286.40 Ce	
1.2	6252.56 Fe I		14	6267.28 Sm II		1.0	6286.41 Re I	
1.6	6253.62 Ce I		5	6267.94 Er I		1.0	6286.83 Os I	
1.4	6253.72 Rh I		1.2	6268.66 U I		3.5	6286.86 Er I	
1.4	6254.22 U II		12	6268.70 Ta I		1.2	6287.36 Ta I	
1.8	6254.29 W I		9	6268.82 V I		1.4	6287.74 La I	
3.0	6255.10 Pr		7	6268.86 Er I		3.0	6287.91 Ta I	
5 c	6255.75 Ho I		2.0	6269.41 Os I		1.0	6288.28 Ir I	
1.0	6256.35 Ce		2.0	6269.42 Nd I		1.2	6288.56 La I	
1.0	6256.36 Ni I		1.4	6270.27 Nd I		2.0	6288.61 Er I	
6	6256.54 Sm I		1.0	6270.29 Ce		1.6 c	6289.03 Pr I	
6	6256.66 Sm II		1.8 c	6271.37 Re I		3.0	6289.34 Ta I	
12	6256.68 Ta I		5	6272.05 Ce II		0.9 h	6289.49 Th II	
6	6256.90 V I		1.2 h	6272.36 Tb I		8	6289.73 Gd II	
8	6257.26 Zr I		4 b	6273.00 Gd GdO		3.5	6289.90 Sm II	
2.5	6257.49 Nd I		0.6	6273.03 Co I		0.9	6290.74 Mo I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
4	6291.34	Eu I	7	6305.15	Gd II	20	6321.90	Re I
0.6	6291.48	U	1.8	6305.19	Sm II	3.5	6321.94	Ho
7	6291.82	Sm II	3.0	6305.26	Pr II	2.0	6322.33	Tb II
1.2	6292.03	U	8 c	6305.36	Ho I	4 c	6322.37	Pr I
4	6292.03	W I	1.6	6305.46	La II	1.2	6322.37	U
2.5 c	6292.43	Tb II	85	6305.67	Sc I	1.8	6322.51	Sm I
14	6292.83	V I	1.4	6306.63	Ce I	0.7	6323.54	Mo I
2.5	6292.84	Nd II	2.5	6306.68	Ho	1.0	6324.66	V I
3.5bl	6292.84	Zr ZrO	5	6307.06	Sm II	6	6325.08	Ta I
3.0	6292.87	Gd I	20	6307.70	Re I	2.5	6325.54	Sm II
2.0	6292.94	Sm I	0.8	6308.15	Yb II	8	6325.91	La I
1.8	6293.32	U I	1.2	6308.26	Nd I	6	6326.11	Er I
0.5	6293.38	Rh I	15	6308.79	Er I	0.6	6326.37	Th I
5	6293.57	La I	4	6309.06	Ta I	0.8	6326.58	Pt I
4	6294.68	Sm II	3.0	6309.11	Gd II	5	6326.84	V I
1.4	6295.22	Ru I	12	6309.58	Ta I	1.8	6327.28	Th I
4 b	6295.46	Y YO	3.0	6309.90	Sc II	10	6327.47	Sm II
3.5	6295.57	Ce I	3.5	6310.02	Ce I	1.8	6328.01	Sm I
14	6296.09	La II	1.2	6310.14	La I	3.0	6330.10	Cr I
12	6296.49	V I	6	6310.49	Nd I	2.0	6330.17	Nd II
2.5	6297.07	Nd I	2.5	6310.92	La II	1.0	6330.62	Ru I
1.0 c	6297.99	Pr	2.0 h	6311.50	V I	0.8	6330.77	U
4 h	6298.33	Rb I	1.6 h	6311.85	Hf I	3.5	6331.35	Gd I
1.8	6298.42	Nd II	2.0 c	6312.24	Ta I	3.5	6331.68	Tb II
1.6	6298.53	U I	5	6312.24	Ti I	0.9	6331.98	Ce I
5	6299.41	Er I	24	6313.02	Zr I	4	6332.91	Ta I
1.0	6299.45	Tm II	1.6 h	6313.78	Eu I	1.6	6333.75	Gd I
3.0	6299.51	Ce II	0.8	6314.66	Ni I	0.6	6334.44	Ir I
1.4 h	6299.54	Hf I	2.5	6314.71	Zr I	2.5	6334.91	Tb II
10	6299.66	Zr I	1.8	6315.78	Sm II	2.5	6335.37	Ce I
11	6299.77	Eu I	1.6 b	6316.20	Y YO	5	6335.82	Eu I
2.5	6300.21	Ce I	2.5	6317.19	Gd I	3.0	6336.10	Ti I
2.0	6300.70	Sc II	1.0	6317.82	Tb II	0.7	6336.12	Ru I
3.0	6301.12	Sm II	0.9 h	6318.00	Ce	1.6	6336.34	Gd I
0.9	6301.41	Th I	0.5	6318.02	Fe I	0.6	6336.55	U
0.6	6301.52	Fe I	2.5	6318.03	Ti I	1.0	6336.74	Tb II
0.8	6301.75	Mo I	1.0 h	6318.12	Pr	1.2	6337.21	Ce I
2.0 h	6301.97	Nd I	1.2	6318.26	La I	1.2	6337.85	Tb II
1.0	6302.02	Pr	1.2	6318.33	Hf I	2.0	6338.10	Hf I
3.0	6302.36	Pr I	0.7	6318.37	Pt I	1.6 b	6338.10	Y YO
2.5	6302.40	Sm II	1.0	6318.58	Eu I	4	6339.09	V I
4	6303.15	Sm II	2.5	6319.53	Rh I	3.5	6340.10	Sm I
1.8	6303.24	W I	2.0	6319.69	Nd II	1.8	6340.36	Zr I
15	6303.41	Eu II	12	6320.39	La II	1.4	6340.69	Ce I
1.0	6303.42	Re I	0.7	6320.41	Co I	5	6341.17	Ta I
6	6303.75	Ti I	1.8	6320.85	Sc II	3.0	6341.51	Nd II
2.0	6303.78	Tb II	1.2	6321.22	Nd I	50	6341.68	Ba I
1.4	6304.03	Pr I	4	6321.35	Zr I	3.0	6342.86	Th I
0.9 h	6304.25	Th II	2.0	6321.59	Tb II	1.8	6343.34	Dy I
1.2	6304.34	Zr I	3.5	6321.75	Sm II	2.0 h	6343.94	Pr I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
3.5	6343.96	Ce II	1.6	6363.23	Gd I	9 h	6386.50	Sr I
3.0	6344.83	Sc I	0.7 h	6363.41	Ru I	2.0 h	6386.77	Sm I
4 bl	6345.10	Zr ZrO	1.0 h	6363.59	Pr	1.0	6386.8	U
6	6345.22	Zr I	2.5 h	6363.94	Sr I	5	6386.81	Dy I
6 h	6345.35	Lu I	2.0	6365.55	Nd II	3.0	6386.86	Ce I
2.5 h	6345.75	Sr I	0.8	6365.79	Lu I	5	6388.19	Er II
2.5	6346.02	Ta I	1.4	6366.00	Lu	6 h	6388.24	Sr I
0.6	6346.27	U	3.5	6366.35	Ti I	1.0	6389.11	Mo I
2.5	6346.65	Gd II	2.0	6367.41	Sm I	7	6389.45	Ta I
2.5	6347.13	Pr II	3.0	6368.28	Sm II	1.0	6389.59	Pr I
2.5	6347.17	Er II	1.2	6369.13	Th I	2.0	6389.80	U I
0.7 h	6347.83	Co I	4	6369.25	Eu I	4	6389.85	Sm II
0.9 h	6348.57	Th II	1.0	6369.87	Y YO	2.0	6390.00	Nd II
3.5	6349.48	V I	3.5 h	6369.96	Sr I	1.2	6390.23	Ru I
8 cw	6350.04	Eu I	0.8	6371.01	Sm I	0.8	6390.32	Ce I
8 d	6350.75	Re I	3.5	6371.11	Ce II	13	6390.48	La II
1.6 c	6350.98	Pr I	5	6372.47	U I	3.5	6390.81	Sm II
1.2	6351.57	Er II	3.5 c	6372.59	Ho I	0.7	6391.12	Mo I
2.5 h	6351.72	Gd I	0.6	6372.99	Ce I	0.5	6391.32	U
2.0	6352.66	Tm I	0.5	6373.01	U	1.6 c	6392.10	Pr I
0.6	6353.52	Ce	3.0	6373.06	Ta I	1.8 h	6392.21	Ta I
3.0	6353.54	Sm	1.6 h	6373.86	Ho I	2.5	6392.78	U I
3.5 c	6354.35	Ho I	1.0	6374.78	U	2.5	6393.02	Ce II
1.6 h	6354.85	Lu I	1.2	6375.97	Nd I	3.5	6393.19	Pr I
2.5 h	6354.98	Cs I	0.5	6375.98	U	1.0	6393.28	V I
1.8	6355.35	Sm I	0.7	6376.45	Ru I	1.0	6393.60	Fe I
1.0	6355.58	V I	3.5	6376.93	Th I	34	6394.23	La I
4	6355.89	Eu I	1.4	6377.62	Pr I	1.2	6395.12	Ce
1.0	6355.95	Nd I	2.5	6378.56	U	0.6	6395.20	Co I
6	6356.14	Ta I	6 bl	6378.56	Zr ZrO	8	6395.45	U I
0.9	6356.40	Tb II	1.4	6378.62	Pr I	1.2	6396.26	Ce I
4	6357.18	Sm	7	6378.82	Sc I	3.0	6396.61	Dy II
2.5	6357.22	Mo I	1.2	6379.07	Ta I	1.6	6397.18	U I
2.0 c	6357.24	Pr I	1.6	6379.36	V I	4	6398.00	Pr II
3.5	6357.30	V I	2.0	6379.64	U	1.6	6398.13	Er I
2.5	6358.13	La II	0.7	6380.05	Sm I	0.8	6398.86	Os I
0.6	6358.61	Th II	1.2 h	6380.19	Hf I	4	6399.05	La II
1.8	6358.82	V I	10	6380.75	Sr I	0.9 h	6399.91	Ce I
5 c	6359.04	Pr I	3.5	6380.95	Gd II	1.6	6400.02	Fe I
2.5	6359.28	U I	2.5	6382.07	Nd II	0.7	6400.36	U II
1.0 b	6359.48	Y YO	1.6	6382.19	Gd II	2.0 h	6400.40	Yb I
0.9	6359.88	Tb II	3.5	6382.73	Eu I	8 cw	6400.93	Eu I
0.6	6360.22	Ce	1.6 h	6382.94	Re I	2.0	6401.07	Mo I
2.5	6360.22	La I	0.7	6383.59	U I	1.6	6401.45	Tm I
5	6360.84	Ta I	5	6383.86	Eu I	5	6402.01	Y I
2.5	6361.27	V I	0.6	6384.67	Mn I	2.0	6403.15	Os I
2.0	6361.43	Nd II	7	6385.20	Nd I	1.4	6403.20	Nd I
2.0	6362.09	Nd II	0.9 h	6386.16	Ce I	1.2 h	6403.98	Sm
12 hl	6362.35	Zn I	4	6386.23	Hf I	3.0	6404.20	W I
1.8	6362.87	Cr I	1.2	6386.47	W	1.8 c	6405.97	Tb II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
2.5	6406.11	Eu I	2.0	6428.65	Nd II	2.0	6446.15	Ce
3.5bl	6406.2	Th ThO	1.4	6428.94	Sm I	6 bl	6446.24	Sc ScO
1.6 h	6406.24	Sm II	4	6429.65	Pr II	1.2	6446.34	Mo I
3.0	6407.00	Zr I	0.7	6429.84	Nd I	2.5	6446.61	La II
6 bl	6408.41	Sc ScO	0.6	6429.91	Co I	2.5	6446.68	Sr I
90	6408.47	Sr I	3.5	6430.07	Ce	2.5	6446.87	Tb II
2.0	6408.55	Gd I	4 c	6430.46	Nb I	1.0	6447.56	Sm
1.6	6408.60	Th II	2.5	6430.47	V I	0.4	6448.04	U
1.6	6409.11	Mo I	20	6430.79	Ta I	1.6	6448.11	La I
1.2 h	6409.52	Hf I	1.0	6430.85	Fe I	0.8	6448.13	Os I
12	6410.04	Eu I	0.7	6430.93	U	10	6449.17	U I
0.9 h	6410.66	Pr I	0.6	6430.95	Tm II	18	6449.81	Ca I
16	6410.99	La I	3.0	6431.00	Sm II	5	6450.24	Co I
5	6411.30	Pr I	1.6	6431.63	V I	1.0	6450.34	La I
9	6411.32	Eu I	4	6431.86	Pr II	16	6450.36	Ta I
1.4	6411.47	Re I	1.4	6431.96	Sm II	36	6450.85	Ba I
0.8	6411.59	U I	2.5	6432.50	Er I	1.6	6451.23	Nd I
1.0	6411.66	Fe I	1.8	6432.65	Nd I	0.8	6451.52	Er I
2.5	6411.90	Th I	1.2	6432.73	Yb II	1.6	6451.62	Zr I
0.6	6412.39	Mo I	1.0	6433.18	V I	0.6	6451.98	Ce
4 b	6412.39	Zr ZrO	2.5 c	6433.22	Nb I	1.6	6452.08	Sm I
10	6413.35	Sc I	3.0	6434.33	Zr I	5	6452.34	V I
2.5 h	6413.41	Ho I	2.0	6434.40	Ce I	1.4 c	6453.44	Pr I
1.2	6413.59	Er II	70	6435.00	Y I	0.8	6454.02	Er II
2.0	6413.61	Th I	0.8	6435.16	V I	7 c	6454.52	La I
3.5	6413.70	Pr II	1.4	6435.34	Sm I	0.8	6454.80	Nd I
1.0	6414.72	Rh I	2.5	6436.41	Ce I	0.8	6454.87	Pr II
0.9	6415.53	Pr I	1.6 h	6436.57	Dy II	2.5	6455.00	Co I
1.4	6416.10	Th II	3.0 b	6437.08	Sc ScO	3.5	6455.60	Ca I
4	6417.50	Sm II	1.6	6437.18	Y I	2.0	6455.60	Sm II
0.6	6417.57	Ru I	1.0	6437.36	Ta I	1.6	6455.83	Ta I
1.0	6417.82	Co I	55	6437.64	Eu II	19	6455.99	La I
2.0 h	6417.97	Yb I	26 h	6438.47	Cd I	0.8	6456.20	Pr I
1.0	6419.10	Ti I	70	6439.07	Ca I	1.4	6456.25	Sm II
0.8	6421.36	Fe I	1.2	6439.93	Eu I	1.4	6457.13	Nd I
6	6421.93	Dy I	0.9	6439.97	Ce I	5	6457.28	Th I
2.0	6422.42	Gd II	1.0	6440.55	Tm I	1.4	6457.55	Sm I
2.0 h	6423.10	Er	1.4	6440.97	Mn I	1.6	6457.63	Zr I
6	6424.37	Mo I	1.0 c	6441.03	Tb II	3.0 b	6457.78	Sc ScO
1.4	6424.43	Tb II	1.9	6441.14	Lu I	8	6457.96	Eu I
1.6	6424.52	Gd I	1.8	6441.31	Er II	3.5	6458.05	Ce I
1.2	6424.80	Th II	0.6 h	6442.81	Pr	0.6	6459.36	Sm I
1.0	6424.89	U II	0.8 h	6443.94	Pr	2.5	6459.92	Ta I
1.2	6425.30	Ce II	3.0	6444.61	Ta I	15	6460.27	Tm I
2.0	6425.79	Nd II	2.0 h	6444.84	Ru I	0.8 h	6460.30	Pr
1.0	6426.17	Zr I	1.0	6444.89	Lu II	1.0	6460.86	Dy I
6	6426.64	Sm II	3.5	6445.13	W I	1.0 c	6461.74	Tb II
3.5	6428.29	Eu I	5	6445.74	Zr I	0.9	6461.89	Ce I
3.0	6428.32	Sm II	1.0	6445.79	Nd II	70	6462.57	Ca I
5	6428.60	Ta I	2.5	6445.87	Ta I	4	6462.62	Th I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
95	6463.12	Lu II	3.5	6486.64	Dy I	4	6504.17	V I
1.0 h	6463.15	Yb II	0.8 h	6486.95	Pr	0.9	6504.46	Nd II
1.6	6463.58	Nd I	4	6487.62	Sm II	5	6505.52	Ta I
3.0	6465.00	U I	0.8	6488.05	V I	0.8	6506.23	La I
1.2	6465.24	Nd II	0.8	6488.35	U	0.4	6506.32	U
2.5 h	6465.79	Sr I	20	6489.10	Yb I	4	6506.36	Zr I
2.0	6466.90	Ce II	9	6489.64	Zr I	1.2	6507.16	Ce
3.0	6467.42	Ce I	0.7 h	6490.34	Co I	1.8 h	6507.70	Sm
1.6	6467.76	Pr	1.0	6490.72	Tm I	1.0	6508.02	W I
1.0 h	6468.44	La I	1.2	6490.74	Th I	1.8	6508.14	Ti I
1.2	6468.60	Dy II	4	6490.82	Sm II	4 bl	6508.15	Zr ZrO
0.6	6468.97	Ce II	1.8	6490.99	Ce I	0.8	6509.01	Ce I
9	6470.21	Zr I	2.0	6491.71	Mn I	4 hl	6509.44	Sm I, SmO
1.8 h	6470.29	Gd I	3.5 h	6491.76	Pr I	1.4	6510.41	Rh I
2.5 h	6470.46	Sm II	6	6492.35	Er I	0.6 h	6511.35	Th II
0.4	6470.55	U	1.8	6492.35	Nd II	5	6511.47	Re I
0.8	6470.70	Eu I	1.8	6493.10	Zr I	0.9	6512.19	Tb II
1.4	6470.86	Tb II	0.6	6493.13	Mo I	2.5	6513.60	Ce II
1.2	6471.20	Mo I	0.8	6493.49	Pr I	8	6514.39	Ta I
0.7	6471.22	Th II	32	6493.78	Ca I	1.8	6514.96	Nd II
1.4	6471.59	Sm I	1.0	6494.90	Pr I	1.4	6515.25	Re I
8	6471.66	Ca I	0.6	6494.93	Ce	1.2	6515.30	Ho I
3.0 c	6471.77	Ho I	3.0	6494.98	Fe I	8	6516.10	Ta I
6	6472.34	Sm II	0.4	6495.35	U	0.7	6517.15	Pr I
4	6473.71	Ce	0.8	6495.59	Nd II	2.0	6517.30	Ce I
5 bl	6473.79	Zr ZrO	3.0 b	6495.90	Sc ScO	1.2 h	6518.33	Y YO
1.2	6473.99	Mo I	0.6	6496.44	Ru I	3.5cw	6518.68	Tb I
1.4	6474.94	Dy I	1200	6496.90	Ba II	1.4	6518.81	Pr
0.8 h	6475.29	Pr II	2.0 c	6497.18	Pr I	1.4	6518.94	U I
2.5	6477.67	Lu I	1.6	6497.69	Ti I	0.6	6519.12	Ce
0.9 h	6477.88	Co I	0.8	6497.84	Nb I	4	6519.59	Eu I
3.0cw	6478.03	Pr II	3.0	6498.19	La II	1.6	6519.70	Rh I
1.4	6479.17	Ho I	5	6498.67	Sm II	1.0	6519.79	Tm I
1.4	6480.11	Gd II	160	6498.76	Ba I	1.4	6519.84	Mo I
1.4	6480.21	Nd II	1.6	6498.94	Pr	1.4	6519.86	Nd II
0.4	6481.72	U	8	6499.65	Ca I	1.4	6520.51	Er I
1.6	6481.77	Er I	1.8	6500.16	Nd I	1.6 h	6520.74	La I
0.6	6482.28	Nd II	2.0	6500.73	Pr I	0.5	6520.85	Os I
60	6482.91	Ba I	1.2 h	6501.23	Y YO	0.4	6520.98	U
1.2	6483.02	Eu I	0.8 c	6501.33	Tb II	1.0	6522.72	Eu I
2.5	6483.62	Dy II	3.0	6501.55	Eu I	0.8	6523.15	Nd II
0.9	6484.35	Zr I	1.2	6502.00	Sm II	5 c	6523.18	Lu I
5	6484.52	Sm II	1.4 h	6502.43	Ta I	0.9	6523.45	Pt I
30	6485.37	Ta I	4	6503.26	Zr I	6 b	6525.62	Sc ScO
0.4	6485.38	U	1.2	6503.27	Ce II	0.6	6526.08	U
4 b	6485.40	Sc ScO	1.0	6503.50	Th II	1.8 h	6526.64	Sm II
1.8 h	6485.55	La I	1.4	6503.62	U I	8	6526.99	La II
4	6485.69	Nd I	55	6504.00	Sr I	0.4	6527.04	U I
3.0	6485.87	Er I	0.8 h	6504.06	Ce I	70	6527.31	Ba I
4	6486.56	Pr I	0.8	6504.10	Pr I	1.8	6527.63	Tb II

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Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
2.5 h	6528.02	Sm I	0.4	6551.44	Co I	0.4	6572.88	Th II
0.8	6528.74	Ru I	2.0	6551.72	Ce I	1.0	6573.65	Ce I
0.6	6528.87	Os I	1.8 h	6551.80	Sm I	1.2	6573.80	Gd I
2.5 h	6529.70	Sm I	0.3	6552.75	U I	1.8	6573.95	W I
0.8 h	6529.73	La II	1.4	6553.07	Nd II	2.5 c	6574.04	Tb II
0.6	6530.68	Ce I	0.6 h	6553.30	Pr I	4	6574.38	Sm II
4 h	6531.34	Th I	0.8 h	6553.84	Y YO	0.7	6574.73	Nb I
8	6531.43	V I	0.5	6554.16	Th I	8	6574.84	Ta I
2.5 h	6532.25	Sm I	6	6554.23	Ti I	1.6 h	6575.18	Ti I
	6533.96	Sm I	1.2	6555.01	U	0.6	6575.54	Tm I
1.4	6532.42	W I	5	6555.67	Ce	2 b	6575.85	Sc ScO
0.6	6533.14	Os I	7	6556.07	Ti I	1.6	6576.56	Zr I
0.6	6534.50	Ce	1.2	6556.31	Er II	1.0	6576.83	Os I
0.4	6534.60	U	1.0 h	6556.50	Hf I	3.0	6576.85	Y I
0.7	6534.64	Pr	6	6557.39	Y I	3.5 c	6577.11	Re I
2.5 b	6535.30	Sc ScO	0.6	6557.58	U	0.5	6577.47	Ce I
1.0	6535.46	U	2.0	6557.78	Er I	1.6	6577.65	Th II
1.2 h	6535.84	Y YO	5 b	6557.84	Sc ScO	0.5	6578.00	Pr I
0.6	6536.58	U II	2.5	6558.02	Dy I	2.5 b	6578.06	Zr ZrO
0.8	6537.48	Ce II	1.2	6558.02	V I	11	6578.51	La I
1.2	6538.14	W I	1.4	6558.97	Nd II	2.5	6579.11	Ce
3.5 h	6538.15	Gd I	1.2	6560.07	Th II	20	6579.38	Dy I
1.0	6538.30	Os I	1.6	6560.08	Ho I	2.0 h	6580.94	Nd II
6	6538.60	Y I	0.3	6560.45	Ru I	3.5	6581.82	Tb II
1.2 h	6538.99	Ho I	0.6	6560.75	Ce	0.8	6582.19	La I
1.4	6539.94	Nd II	2.0 h	6561.60	Ta I	0.3	6582.78	U
1.4	6540.48	Pr I	1.2	6563.22	W I	7	6583.46	Er I
2.5	6541.53	Er I	1.8	6563.42	Co I	2.0	6583.91	Th I
7	6542.76	Sm II	0.8	6563.47	Ce	0.5	6584.59	Pr
2.5bl	6542.90	Zr ZrO	2.0cw	6564.26	Ta I	2.0	6584.87	Y I
0.8	6542.97	U I	2.0	6564.63	Pr II	0.8	6585.13	Ta I
10	6543.16	La I	5	6564.78	Gd I	6 h	6585.21	Sm II
2.0	6543.51	V I	2.0	6565.44	La I	2.0	6585.71	Nd II
2.5	6544.57	Sm II	1.8 h	6565.62	Ti I	3.0 h	6586.51	Cs I
3.0	6544.61	Nb I	0.8	6565.71	Ce	1.2 c	6587.16	Ta I
1.2	6544.91	Re I	0.8	6565.88	V I	1.8	6587.23	Hf I
0.6	6546.24	Fe I	4	6566.75	Pr II	1.0 h	6587.54	Sm I
5	6546.28	Ti I	4 b	6566.88	Sc ScO	0.6	6587.83	U
10	6546.79	Sr I	5	6567.87	Eu I	1.8	6588.03	Nd II
1.0	6548.28	Dy II	1.2	6568.00	Gd II	2.0	6588.54	Th I
0.5 h	6549.12	Eu I	0.8	6568.47	Nd	4	6588.91	Sm I
2.0	6549.25	Gd I	20	6569.31	Sm II	16	6589.72	Sm II
1.6	6549.54	Nd II	2.5	6569.43	Zr I	0.9	6590.05	U II
2.5 h	6549.77	Sm II	0.8	6569.61	Th II	0.4	6590.90	Mo I
1.6 h	6549.77	Tl I	5 h	6570.67	Sm II	0.9cw	6591.00	Nb I
0.6	6549.88	U	0.6	6570.96	La II	1.2	6591.43	Nd II
1.6	6550.19	Nd II	0.6	6571.04	Pr I	1.0	6591.48	Th I
17	6550.26	Sr I	1.0 h	6572.58	Y	1.8	6591.50	Sm
3.0	6550.54	Zr I	1.4	6572.65	Nd II	3.5	6591.60	Gd I
8	6550.97	Ho I	2.0	6572.78	Ca I	4	6591.99	Zr I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
4 cw	6592.52	Re I	0.9 h	6611.20	Mo I	0.6	6628.65	U
0.9	6592.92	Fe I		6611.28	Lu	4.0	6628.88	Ce I
1.8	6593.42	Gd I		6611.58	Lu	3.0 h	6628.88	Sm II
3.5	6593.46	La I	3.0cw	6611.80	Lu II	13	6628.99	Ho I
1.8	6593.52	Er I		6611.95	Lu	5	6630.14	Nd I
1.4	6593.66	Tb II		6612.04	Lu	1.6	6630.16	Rh I
0.8 h	6593.69	Pr	1.6	6611.64	W I	2.0 h	6630.61	Sm II
0.3	6593.74	Ru I	0.8 h	6611.76	Dy I	0.7 h	6631.1	Pr
3.0	6593.79	Eu I	9	6611.95	Ta I	0.8	6631.21	La I
2.0	6593.94	Th I	2.0	6611.99	Nd I	1.4 h	6632.04	Pr
1.8	6594.16	Dy II	3.0	6612.06	Ce	1.6	6632.24	Ho I
65	6595.32	Ba I	8	6613.75	Y II	6 h	6632.28	Sm II
1.2	6595.47	Pr I	1.6	6614.15	Nb I	1.8	6632.44	Co I
0.8	6595.90	Co I	0.7	6614.56	Os I	1.0	6633.26	V I
0.8	6596.71	Zr I	0.4	6615.43	Os I	6	6634.36	Gd II
0.8	6598.84	Zr I	1.2	6615.88	Nd I	1.0	6636.15	Nd
4	6599.11	Ti I	4	6616.59	La I	1.6 h	6636.49	Y I
0.7	6599.61	Ce I	6	6616.65	Pr I	0.8	6636.53	La II
2.5	6600.17	La I	1.4	6616.75	Er II	0.3	6637.16	Mo I
3.5 d	6600.58	Ho I	0.8	6617.06	Th II	2.0	6637.19	Nd II
8	6601.10	Er I	30	6617.26	Sr I	1.0 c	6637.25	Re I
0.4	6601.46	U I	1.6	6617.61	Sm II	1.6	6637.62	Er I
1.8	6601.76	Nd I	2.0bl	6617.94	Sc ScO	4	6637.96	Nd II
6	6601.83	Sm II	0.7	6618.20	Ru I	0.9	6639.25	Dy I
0.2	6602.68	U	1.2	6618.42	Pr	4	6640.08	Gd I
4	6603.27	Zr I	1.8 c	6618.53	Nd I	1.6	6640.14	Tb II
0.5	6603.34	U	14	6619.13	Mo I	0.8 c	6642.27	Tb II
1.2 h	6603.55	Eu I	1.0	6619.15	Lu II	1.2	6642.76	Gd I
0.9	6603.98	U I	2.0	6619.35	Nd I	2.0	6642.79	La II
14	6604.56	Sm II	2.0	6619.95	Th II	2.0	6643.41	Dy I
7	6604.60	Sc II	2.5	6620.52	U I	8	6643.54	Sr I
28	6604.94	Ho I	1.2	6620.56	Zr I	1.6	6643.54	Yb I
7	6604.97	Tm I	6	6621.30	Ta I	1.8	6643.64	Ni I
10 cw	6605.19	Re I	1.0	6621.68	W I	1.0	6643.79	V I
0.7	6605.39	Ce I	2.5	6621.77	U	3.5	6643.98	Gd I
2.0	6605.42	Th II	1.2	6622.49	Y I	2.5	6644.41	La I
4	6605.97	V I	1.0	6622.82	U	3.0	6644.60	Hf II
0.9	6606.16	Nb I	1.4	6623.00	Ce I	1.8	6644.66	Th II
1.6	6606.33	Ce I	0.8	6623.54	V I	2.0bl	6645.08	Sc ScO
1.6	6606.86	Ce II	3.0 c	6623.91	Re I	160	6645.11	Eu II
1.0	6607.15	W I	0.6	6624.57	Mo I	1.4	6645.16	La I
3.0	6607.17	Tb II	0.4	6624.73	Ir I	1.8	6645.41	Tb II
0.9	6607.28	Nb I	4	6624.85	V I	1.8 h	6646.22	Sm I
6	6607.47	Ho I	0.9	6625.28	Sm II	0.7	6646.54	Th II
1.2	6607.83	V I	1.0	6625.29	U I	1.2	6646.85	Gd I
3.5	6608.26	La I	0.9	6626.98	Nb I	1.2	6647.06	Hf II
1.0	6609.04	W I	0.6	6627.25	Tm I	1.5	6647.12	Pr I
1.6	6609.85	Pr I	0.8	6627.80	Rh I	0.8	6647.79	U
3.0bl	6609.99	Sc ScO	1.4	6628.35	Ho I	0.5	6648.50	Th II
1.2	6610.04	Gd II	1.0	6628.43	Gd I	0.3	6648.95	Th I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
1.2 d	6648.98	Er I	0.4	6671.29	U	0.4	6691.21	U I
	6649.02	Er I	3.0 c	6671.40	La II	1.2 h	6691.83	Y I
3.0 h	6649.02	Sm II	7	6671.51	Sm I	1.0	6692.71	Th II
4	6650.38	Mo I	6	6673.41	Pr II	1.2	6692.86	Gd I
7	6650.57	Nd II	8	6673.73	Ta I	3.5	6692.87	La I
3.5	6650.61	Y I	8	6673.78	Pr II	1.2	6692.93	Tm I
6	6650.81	La I	32	6675.27	Ba I	1.4	6693.12	W I
1.8	6650.89	Ce	14	6675.53	Ta I	1.8	6693.38	Tb II
0.8 h	6651.42	Ce I	1.4	6675.54	Ce II	10	6693.55	Sm II
2.0bl	6651.46	Ti TiO	1.4	6676.92	U	1.2	6693.61	Ta I
3.0	6651.61	Sm II	3.0 c	6677.14	Lu I	0.6	6693.66	V I
3.0cw	6652.39	Re I	2.0	6677.18	Ti I	32	6693.84	Ba I
3.0	6652.77	Ce II	7 cw	6677.33	Nb I	11	6693.96	Eu I
1.0 h	6652.98	Ho I	9	6677.94	Tb II	6 cw	6694.32	Ho I
1.2	6653.55	Gd I	1.8	6677.99	Fe I	1.6 h	6694.69	Sm II
1.0	6654.27	Dy II	1.0	6678.01	Zr II	0.6	6694.75	Y I
2.5bl	6654.42	Sc ScO	1.2	6678.17	Yb I	0.7	6694.92	Gd II
5	6655.67	Nd I	1.2	6678.41	W I	1.0	6698.65	Nd II
4	6656.19	Sm II	1.8	6678.52	Nd II	0.7	6699.25	La I
0.8	6656.81	U I	0.3	6678.71	Th I	1.4 h	6699.26	Y I
8	6656.83	Pr II	0.6	6678.81	Co I	0.4 h	6699.32	Pr
2.5	6657.73	Tm I	0.3 h	6678.89	Mo I	0.8	6699.85	La I
3.0	6658.40	Dy I	10	6679.21	Sm II	2.0 b	6700.48	Sc ScO
0.8	6658.64	Tm I	1.2	6679.56	Gd II	1.4	6700.66	Dy II
0.5 h	6658.68	Th II	1.8	6679.81	Ce I	3.5	6700.70	Ce I
1.0	6659.40	Hf I	3.0	6680.14	Nd II	6	6700.71	Y I
1.0	6659.68	Mo I	2.0 c	6680.46	Ho I	0.4	6700.83	U
10 cw	6660.84	Nb I	0.4	6681.15	U	0.8 h	6701.06	Eu I
3.0bl	6661.01	Sc ScO	4	6681.23	Gd II	3.0	6701.20	Nb I
1.8	6661.08	Cr I	2.5 h	6681.53	Sm II	0.6	6701.68	U
7	6661.40	La I	2.5 c	6681.62	Ho I	0.8	6701.80	Er II
1.4	6661.41	Ce I	1.6 h	6682.02	Ho	1.0	6702.12	Gd II
4.0	6661.69	Dy I	1.6 h	6683.28	Re I	1.0	6702.12	Zr I
0.6	6661.81	Os I	1.8	6683.38	U I	4 cw	6702.61	Tb II
1.2cw	6662.24	Ta I	2.5	6684.00	Ta I	2.0	6703.61	Sm I
2.5	6662.27	Th I	3.0	6685.21	Eu I	1.0	6704.04	Th II
1.6	6662.52	Ho I	1.2	6686.08	Ir I	1.2	6704.18	Gd II
2.0	6663.14	Ru I	2.0	6686.59	Ce	7 d	6704.38	Ce I
1.2	6663.51	Er I	1.5	6687.20	Er I	2.0 b	6705.93	Sc ScO
1.8	6664.40	Y I	13	6687.58	Y I	1.4	6706.03	Ce I
1.8	6665.65	Ce I	0.5 h	6687.6	Pr	1.2	6706.46	Ta I
0.6	6665.94	Tb II	2.5 h	6687.79	Sm II	2.0 c	6706.79	Tb II
2.0 h	6666.55	Ti I	0.4	6687.87	Mo I	3.0 h	6707.45	Sm II
2.5 h	6667.22	Sm II	2.0	6688.18	Zr I	1.0	6707.52	Ru I
14	6667.85	Yb I	0.8	6689.51	Tb II	0.8	6707.59	U
10	6667.90	Dy I	5	6690.00	Ru I	3600	6707.84	Li I
1.0	6669.26	Cr I	0.8	6690.02	Er II	0.6	6708.07	V I
1.6	6669.65	Nd II	1.4	6690.47	Mo I	2.0	6709.39	Ta I
1.2	6670.21	Dy I	0.3	6691.08	Mo I	15	6709.50	La I
1.6	6670.37	Nd I	2.5 b	6691.21	Ti TiO	1.6	6709.61	Zr I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
0.4	6710.16	Ce I	1.0	6728.01	Tm	5 c	6753.00	V I
1.0	6710.42	Pt I	0.7	6728.04	Mo I	5	6753.04	La I
1.4 h	6710.45	Eu I	2.0	6728.71	Ce I	1.6	6753.91	Gd II
0.8	6710.57	U	2.0	6729.54	Ce I	2.5	6753.97	Mo I
1.0 c	6711.30	Re I	3.0	6729.56	Os I	0.7	6754.29	Tb I
1.6	6712.27	Nd I	1.4	6730.45	Ru I	1.6	6754.61	Hf II
2.0	6712.62	Sm II	10	6730.73	Gd I	2.5 h	6754.68	Sm II
1.0 h	6713.18	Dy I	17 d	6731.84	Sm II		6754.85	Sm I
3.0	6713.20	Y I	0.6	6732.78	La II	3.0	6754.91	Ta I
1.0	6713.48	Ce I	0.6	6733.21	Ce II	0.6	6754.93	U I
3.0	6713.48	Hf I	1.0	6733.76	Th I	1.4	6755.01	Tb II
0.6 h	6713.69	Tl I	8	6733.98	Mo I	0.6	6755.08	Ce II
1.0	6713.98	Th I	10 d	6734.06	Sm II	1.0 c	6755.85	Ta I
1.6	6714.09	La II	6 d	6734.81	Sm II	2.5	6756.45	Th I
1.0	6714.15	Nd	0.7 c	6734.86	Tb II	0.7	6756.54	Ru I
0.8	6714.44	Ta I	1.2 h	6735.76	Lu I	1.4	6757.69	Dy I
1.2 c	6714.98	Tb II	3.5	6735.99	Y I	2.5	6759.25	Sm I
0.6	6716.00	Hf I	0.8 h	6736.17	Dy I	8	6759.87	Er I
3.0	6716.68	Ti I	1.4	6736.80	U	2.0	6760.02	Pt I
1.2	6717.51	U	1.4	6736.89	Pr I	0.8	6760.12	V I
4 h	6717.68	Ca I	4	6737.79	Nd II	0.6 c	6761.19	Re I
2.5	6717.88	Zr I	8	6737.87	Sc I	1.4	6761.69	Er II
1.6	6718.14	Gd II	2.0	6739.23	Tm	7	6762.38	Zr I
1.4	6718.30	Ru I	4	6739.40	Sc	2.5	6762.96	Er I
0.6	6718.68	La II	3.5	6739.88	Nb I	1.6	6763.01	Nd I
1.0	6719.19	Th I	6	6740.11	Nd II	1.0	6763.50	Mo I
1.2	6720.32	Ce II	6 c	6740.73	Ta I	1.4	6763.78	Nd I
0.8	6720.84	U II	8	6741.47	Sm II	0.5	6764.43	W I
1.2	6720.99	Er I	0.4	6742.47	U	1.2	6764.52	Er I
3.5	6721.37	Tm I	4	6742.54	Nd I	1.4	6764.61	Nd
3.0	6721.93	Er I	0.8	6742.87	Th I	0.8	6764.65	Ce I
1.6cw	6722.34	Ho I	9	6743.12	Ti I	0.3	6764.92	Mo I
1.5	6722.76	Er II	0.9 h	6743.77	Dy II	0.8	6765.69	Th I
6 d	6723.07	Sm I	2.0	6744.70	Ce II	6	6765.96	Dy I
	6723.26	Sm I	3.5	6744.88	Eu I	4 c	6766.49	V I
20 hs	6723.28	Cs I	4	6745.05	Ho I	2.0	6766.52	Sm II
6 c	6723.62	Nb I	1.6	6746.08	Mo I	1.2	6766.62	Er I
1.8bl	6723.95	Ti TiO	4	6746.27	Mo I	1.4	6766.74	Ho I
4	6724.73	Sm I	0.5	6746.56	W I	2.0	6766.95	Ru I
0.8 h	6724.79	Dy I	1.4	6746.89	Ce	1.0 h	6767.50	Tm
3.0	6725.88	Sm I	4 c	6747.17	Pr I	0.8	6767.65	Ce I
1.0	6726.35	Tm	4	6747.98	Dy I	2.5	6767.77	Ni I
0.4	6726.52	Ce	3.0	6748.13	La I	1.0	6768.44	Er II
0.8	6726.89	U	2.0 c	6749.28	Pr	0.4	6768.64	U
0.7	6727.21	Tb II	1.4	6749.44	Ce I	2.0	6768.70	Yb I
2.0	6727.46	Th I	1.0 h	6750.29	Dy I	2.0	6768.94	Er II
2.0	6727.61	Yb II	3.5	6751.22	Re I	8	6769.16	Zr I
3.0	6727.74	Nd II	5	6752.35	Rh I	1.4	6769.81	Tb II
2.0	6727.83	Gd II	6	6752.67	Gd II	1.0	6769.95	Hf I
0.4	6727.96	U I	3.5	6752.73	Zr I	1.2	6770.10	Th II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
0.5	6770.15	Ce	1.2	6787.23	Ru I	0.7	6803.29	Ce I
1.0	6770.37	Ta I	0.8	6787.43	Dy I	2.0	6803.87	Er II
0.6	6771.03	U	1.6 h	6787.48	Eu I	5	6804.00	Nd II
2.0	6771.06	Co I	0.8	6787.73	Th I	0.7	6804.73	Th II
6	6771.74	Ta I	0.9	6787.90	Er I	0.6	6805.28	W I
1.6 h	6771.85	Ba I	0.6	6787.98	Mo I	1.1	6805.64	Dy I
1.0	6772.03	Gd I	2.0	6788.52	Tm I	1.6	6806.61	Os I
1.0	6772.17	Th I	0.8	6788.84	Th I	1.2	6807.36	Dy II
1.0	6772.32	Ni I	0.6	6788.94	Mo I	1.4	6807.50	Sm I
2.5	6772.89	Zr I	3.0cw	6788.99	Ta I	2.4	6807.83	Ce I
3.0	6773.40	Er I	8	6789.27	Hf I	3.0 h	6808.31	Sm I
3.0cw	6774.25	Ta I	9	6790.00	Sm II	0.4 d	6808.76	U
10	6774.26	La II	1.0 c	6790.06	Ta I	2.5 h	6808.86	La II
4	6774.29	Ce II	2.0	6790.30	U I	1.4	6808.89	Ce I
2.5	6774.54	Pd I	1.0	6790.38	Dy I	3.0 c	6810.46	Ta I
3.0 c	6774.68	Ho I	5	6790.41	Nd II	1.0	6810.54	Th II
3.0	6775.02	Ru I	3.0	6790.85	Zr I	1.4cw	6811.04	Ho I
5	6775.59	Ce I	4	6790.93	Er I	0.8 h	6811.66	Ce
1.8	6776.14	Er II	18	6791.05	Sr I	1.2	6811.88	Pr
0.8	6776.89	U	0.8	6791.23	Th I	0.8	6812.03	Mo I
1.0	6777.94	Tm	2.0	6791.53	Os I	2.0 h	6812.30	Nd II
3.0	6778.19	Sm II	1.2 c	6792.48	Tb II	2.0	6812.40	V I
1.4	6778.28	Ce I	2.0 h	6792.55	Sm II	0.8	6812.77	Th II
0.8	6778.31	Th I	1.4	6793.7	Ho I	1.8cw	6812.91	Pr
6 h	6778.61	Sm II	16	6793.71	Y I	0.2	6812.98	U I
12	6779.77	Tm I	4 c	6793.77	Lu I	13 c	6813.25	Ta I
1.6	6779.86	Er I	0.8	6793.81	Ce	1.2	6813.4	Sm II
2.0 h	6780.03	Sm II	14	6794.20	Sm II	20 c	6813.41	Re I
0.9	6780.12	Th I	1.1	6794.30	Dy I	0.8	6813.51	Ru I
1.2	6780.21	Ce	12	6794.58	Tb II	1.2	6813.66	La II
1.4	6780.41	Th I	1.2	6795.31	Nb I	0.4 d	6813.75	U
0.4	6780.62	U	6 h	6795.41	Y II		6813.81	U
2.0	6780.73	Er I	0.4	6796.46	U	1.4	6814.10	Pr
1.2	6780.74	Ce I	1.2	6796.65	Rh I	1.4	6814.56	Gd I
2.5 h	6781.17	Sm II	0.7	6796.68	Zr I	2.5	6814.94	Co I
1.6 h	6782.01	Tm I	0.6	6796.73	La I	0.8	6814.95	W I
3.5 h	6782.54	Eu I	1.6	6796.93	Er II	1.8	6815.16	Y I
0.4	6782.70	U	6 cw	6798.68	Pr I	1.2	6815.29	Ce
0.4	6782.85	U I	1.0	6799.27	Ta I	2.0	6816.02	Nd II
3.0	6782.95	Sm II	55	6799.61	Yb I	13	6816.06	Eu I
1.6	6783.39	Gd I	0.8 h	6799.88	Mo I	3.0	6816.49	Gd I
7	6784.52	Pd I	1.8	6801.34	Nd I	4	6817.08	Sc I
3.0	6784.98	V I	0.7	6801.75	Ce	1.0	6817.70	Pr
0.8 c	6785.12	Pr	0.8	6802.62	Mo I	1.6	6818.24	Dy I
3.0	6785.12	Tb II	16	6802.72	Eu I	2.0	6818.25	Ce I
6 c	6785.43	Ho I	3.0 h	6802.96	Sm I	1.0	6818.29	U I
1.2	6786.32	V I		6803.1	Sm I	15	6818.94	Hf I
3.0	6786.33	Gd II	2.5	6803.06	Nd I	1.6	6819.36	Ta I
1.4	6787.15	Zr II	1.0 h	6803.15	Y I	6	6819.52	Sc I
1.2	6787.18	Gd I	1.1 h	6803.20	Dy II	1.4 h	6820.27	Tm

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
0.8	6820.28 W I		4	6832.89 Zr I		1.2	6848.92 Mo I	
1.6cw	6820.38 Ho I		0.4 h	6833.42 Pd I		2.5	6849.26 Zr I	
3.5	6820.76 U I		0.6	6833.67 Zr I		1.2 c	6849.35 Nb I	
2.0	6820.90 Gd I		3.0	6834.05 La II		1.0	6849.89 Gd I	
2.0 h	6820.91 Sm I		0.8 h	6834.21 Ce		1.2	6850.07 Hf I	
2.5	6821.64 Ho I		1.3 h	6834.30 Eu I		1.8 c	6850.55 Pr II	
4	6823.78 La I		1.8	6834.92 Th I		1.2	6850.83 Ta I	
1.4	6823.88 Ru I		6	6835.03 Sc I		0.6 h	6852.10 Dy I	
2.0	6824.17 Ru I		24	6835.44 Dy I		1.7	6852.23 Nd I	
1.2	6824.56 U		1.4	6835.92 Er I		1.2	6852.56 Zr I	
1.0	6824.68 Th I		1.8 h	6837.20 Sm		1.2	6852.90 Pr	
1.4 c	6824.96 Ta I		2.0	6837.90 La II		0.8 h	6852.97 Ho	
1.4	6825.35 Nd I		2.5	6838.33 Sm I		11	6853.00 Dy I	
2.5	6825.46 Er I		3.0	6838.88 Mo I		1.4 h	6853.54 Sm I	
1.0	6825.63 Mo I		0.9	6839.58 V I		1.2	6853.60 Ce	
1.8 c	6825.72 Ho I		1.4 h	6839.64 Sm II		0.4	6853.73 W I	
2.5	6825.99 Er I		0.7	6839.94 Ce		0.9	6854.11 Th I	
1.0	6826.43 Ce I		2.0	6840.93 Eu I		2.0	6854.16 Tm	
1.4	6826.56 Hf I		3.0 h	6841.75 Sm I		2.0 h	6854.50 Sm II	
1.4	6826.59 Lu II		0.9	6841.90 V I		0.8	6854.63 Zr I	
0.8 h	6826.62 Ho		6	6842.60 Pt I		11	6856.03 Sm II	
14	6826.93 U I		2.5	6842.66 Nd II		3.0	6856.50 Dy I	
1.6	6826.96 Tm		0.5 h	6843.80 Dy I		1.6	6856.55 Ce	
1.2	6827.16 Dy I		1.2 d	6844.26 Ce		1.5	6857.00 Nd I	
1.6	6827.33 Rh I			6844.49 Ce		3.5	6857.13 Gd II	
3.5cw	6827.70 Pr II		13	6844.28 Tm I		1.0	6857.21 Er I	
4	6828.11 Nb I		1.0	6844.48 Pr		1.4	6857.68 Rh I	
12	6828.25 Gd I		2.0	6844.64 Ti		0.4	6857.90 Zr I	
0.6	6828.41 Dy II		8	6844.71 Sm II		1.4 h	6858.12 Sm I	
0.7	6828.42 W I		2.0 h	6844.83 Eu I		1.2	6858.24 Y II	
4	6828.78 Zr I		4	6845.24 Y I		3.5	6858.70 Hf I	
1.4 d	6828.87 Mo I		1.2	6845.33 Zr I		0.7 h	6859.03 La II	
	6829.05 Mo I		1.0 h	6845.54 Pr		2.0	6860.39 Ti	
1.4	6829.04 Th I		9	6845.77 Tm I		17	6860.93 Sm I	
1.6	6829.14 Tm		1.0	6845.84 Dy I			6861.10 Sm II	
1.0	6829.37 Ce		1.0	6846.25 U I		4	6861.47 Ti I	
3.5	6829.54 Sc I		1.6	6846.34 Zr I		6	6862.82 Sm II	
1.4	6829.75 Ce		4 d	6846.54 Sm II		1.8	6864.25 Gd I	
4	6829.86 Sm II		4	6846.60 Gd II		42	6864.54 Eu I	
28	6829.90 Re I		4	6846.72 Nd II		1.2	6865.13 Ta I	
0.7 c	6829.94 V I		1.0	6846.72 Pr		6	6865.20 Er I	
0.6	6830.01 Ir I		1.0	6846.78 Ce II		6	6865.69 Ba I	
2.5	6830.54 Sm I		1.7	6846.93 Nd		1.8cw	6865.85 Ho I	
2.0	6830.57 Pr		9	6846.97 Zr I		17	6866.23 Ta I	
2.5	6831.11 Tm		1.6 h	6847.04 Eu I		1.2	6867.11 Sm I	
0.7	6831.52 Ru I		1.8	6847.25 Ce I		1.2 h	6867.85 Ba I	
1.0	6832.00 Ta I		0.8 h	6847.44 In I		0.7	6868.45 Th I	
1.2	6832.44 V I		8	6848.11 Er I		2.5 h	6869.07 U	
1.2	6832.49 Y II		2.0	6848.16 Sm II		1.2 c	6870.55 Pr	
0.6	6832.71 U I			6848.31 Sm I		0.8 c	6870.88 V I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
0.9	6870.92	Nb I	1.6 c	6892.96	Ho I	2.0	6909.81	Sm II
0.7	6871.56	V I	1.4	6893.69	Ce	2.5	6909.85	Th II
2.5	6872.40	Co I	0.6	6894.00	V I	1.6 h	6910.17	Eu I
4 h	6872.43	Sm II	1.4bl	6894.5	Th ThO	4	6911.23	Th I
1.5	6873.07	Nd	1.0	6894.57	Ce I	2.5hl	6911.30	K I
1.2	6873.12	Er I	0.6	6894.58	Dy I	4	6911.40	Hf I
2.0	6873.74	Er I	0.6	6895.55	Dy I	3.0	6911.48	Ru I
1.0	6873.92	Ti I	1.8	6896.00	Y II	1.0	6912.27	Dy II
3.5	6874.18	Tb II	5	6896.37	Tb II	1.4	6913.19	Ti I
2.2	6874.62	Nd II	2.2	6896.68	Nd I	1.6cw	6913.47	Ho I
1.0	6874.75	Th I	1.2	6896.77	Ta I	2.5	6914.01	Mo I
1.8	6874.77	Er I	2.0	6897.29	Nd	1.2	6914.56	Ni I
1.4 h	6875.27	Sm II	1.6	6897.53	Er II	3.5 h	6914.82	Eu I
14	6875.27	Ta I	1.8	6897.95	Ho I	1.2	6915.31	U I
1.2	6876.00	Nd II	2.0	6897.98	Dy II	0.9	6915.87	Tm
0.4	6876.02	W I	0.8	6898.01	Mo I	12	6916.57	Gd I
1.8	6876.36	Nb I	2.5	6898.21	Eu I	1.2	6916.69	Tb II
5	6876.75	U	1.4	6898.48	Ce	1.0	6916.70	Ho I
1.8 h	6877.10	Sm II	0.9	6898.58	Tm	2.0	6916.87	Zr I
3.0	6877.49	Ta I	0.8	6898.98	Mo I	2.5	6917.05	U I
48	6878.38	Sr I	1.2	6899.10	Ce	1.8	6917.24	La I
0.6	6878.70	Os I	9	6899.34	Dy II	8	6917.31	Lu I
2.0	6879.50	Sm I	4 h	6899.95	Tb II	1.0	6918.30	La I
2.5	6879.94	Rh I	0.4 h	6900.13	In I	2.0	6918.32	Nb I
3.0	6880.01	Er I	1.4	6900.28	Sm II	2.0 d	6918.78	Sm I
0.5 h	6881.62	Cr I	6	6900.43	Nd II		6919.03	Sm I
0.9 h	6882.38	Cr I	3.0	6900.55	Ta I	1.2	6919.27	Ce II
2.0 h	6883.03	Cr I	3.0	6900.59	Zr I	2.5	6920.62	Gd II
0.6	6883.23	Zr I	1.6	6900.73	Gd II	0.6	6922.23	Zr I
1.0	6883.36	Ho I	1.7	6901.33	Nd	1.2 h	6923.09	Tb II
1.2	6884.13	Er	0.5	6901.58	Os I	12	6923.23	Ru I
0.9	6884.72	Pr	3.5	6902.08	Tb II	3.5	6923.86	Nd I
4 h	6885.16	Sm II	12	6902.10	Ta I	2.5 h	6924.13	Cr I
0.7 d	6885.51	Ce	1.0	6902.55	U I	4	6924.83	Ce I
	6885.72	Ce	1.2 c	6902.89	Nb I	1.8	6924.99	Gd II
1.6	6886.28	Mo I	7 h	6903.67	Eu I	1.6 h	6925.20	Cr I
0.5 h	6886.48	Dy II	1.6 h	6903.80	Ho I	6	6925.24	La I
1.5	6886.86	Nd I	2.0	6904.36	Zr I	0.9 h	6925.48	Dy I
2.5	6887.22	Y I	1.4	6904.51	Sm II	1.4	6926.08	Er I
2.5 h	6887.42	Sm II	0.8	6904.58	Ce	0.9	6926.19	Hf I
2.5	6887.63	Gd II	2.0	6906.07	Nd I	0.7	6926.29	Er I
1.2	6887.74	U I	2.5	6906.22	Sm I	2.5	6926.49	Gd I
12	6888.29	Zr I	3.0	6906.57	Dy II	2.5	6926.87	Nd II
1.4	6888.50	Ho I	3.0	6907.37	Zr I	2.5	6927.03	Sm II
3.0	6888.90	Dy I	1.6	6908.07	Nb I	11	6927.38	Ta I
2.5	6889.30	Th	1.0	6908.20	Mo I	11	6928.54	Ta I
1.2	6892.36	Mo I	1.0	6908.26	Er I	2.0	6929.54	Dy I
0.8	6892.45	Er I	0.8	6908.26	Y I	1.8	6929.60	Sm II
12	6892.59	Sr I	0.5	6908.29	W I	0.8	6929.88	Ir I
1.0	6892.76	Pr	0.5	6909.31	Ce	2.5	6930.41	Sm II

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
0.7	6931.40	Mo I	0.9	6953.00	Dy II	1.2 h	6979.82	Cr I
1.4	6932.16	Nd I	0.6	6953.78	Mo I	2.5	6979.88	Y I
1.6	6932.38	Zr I	15	6953.84	Zr I	1.0 c	6980.18	Pr
1.0	6932.62	Dy II	3.5	6953.88	Ta I	0.6	6980.37	Mo I
1.6 h	6933.15	Ti I	1.8 h	6954.52	La II	3.0 h	6980.86	Gd I
1.2	6933.52	Y I	18	6955.29	Sm II	2.0	6980.91	Hf II
1.4	6934.04	Yb II	1.4hl	6955.3	Ho I	3.0	6982.01	Ru I
1.0	6934.10	Mo I	1.2	6956.02	Os I	2.0 h	6982.47	Dy I
0.8	6934.27	W I	0.6	6957.63	Dy I	1.8	6982.65	Nd
4	6935.01	La I	1.8	6957.74	Gd II	3.5	6983.49	Cs I
1.8	6936.44	Nd	1.0	6958.04	Y I	1.8	6983.52	Ta I
1.4	6937.40	Tm	6	6958.08	Dy I	0.9 h	6983.53	Gd I
0.5	6937.81	Co I	3.0	6958.10	La II	1.4	6983.83	Ce
2.0	6938.36	Er I	1.4	6958.97	Sm II	2.0	6984.16	Sm II
2.5	6938.67	Nd	1.8	6959.24	Gd II	1.2	6984.30	W I
5 hl	6938.98	K I	0.8	6960.64	Mo I	0.5	6984.67	Mo I
0.6 h	6939.33	Ta I	0.6	6961.48	Mo I	0.8	6984.95	Os I
1.4	6939.44	Ce I	0.7 b	6963.12	Sc ScO	1.0	6985.11	Ho
4 cw	6939.49	Ho I	0.7	6964.12	W I	1.4 h	6985.25	Nd I
0.6	6939.72	Dy I	1.6	6964.33	Gd I	6	6985.89	Gd II
3.5	6940.14	Nd	2.5 d	6964.64	Nd I	4	6986.04	Ce
5	6941.39	Nd II	8	6965.67	Rh I	1.2	6986.09	Nb I
2.5	6941.56	Sm II	14	6966.13	Ta I	1.2	6987.72	U
0.8	6942.17	Dy I	6	6966.44	Zr I	2.0	6988.36	Sm I
1.2 h	6942.52	Mn I	2.5	6968.65	Sm II	1.2	6988.75	Gd II
6	6943.61	Th I	0.6	6969.49	Ta I	2.0	6988.94	Mo I
1.6 h	6943.70	Ti I	1.0 h	6970.38	Pr	0.8	6989.32	Er I
1.4	6943.96	Lu II	0.6 h	6970.40	Ce	1.0	6989.60	Tb II
0.7	6944.95	Er II	0.9	6970.51	Dy I	9	6989.66	Th I
0.4	6945.21	Fe I	0.6 c	6971.31	Ta I	1.0	6989.96	Mn I
0.6 h	6945.35	Dy I	10	6971.53	Re I	4	6990.32	Nb I
2.0	6945.98	Gd II	0.7	6971.53	Ta I	0.7bl	6990.68	Sc ScO
0.8	6946.07	Nb I	1.8	6971.66	Gd II	15	6990.84	Zr I
0.4	6946.75	Mo I	0.8	6972.49	Nb I	2.0	6991.31	Dy I
1.6 c	6946.87	Ta I	1.0	6972.91	Rh I	0.7	6991.69	Mo I
0.8	6947.39	Mo I	1.0	6973.03	Er I	9	6991.92	Gd I
3.0	6948.46	Zr I	20 hs	6973.29	Cs I	4	6993.04	Th II
2.5	6948.58	U II	2.5	6973.50	Ce II	2.5	6993.18	Gd I
1.8	6949.23	Sm II	1.0	6974.50	V I	0.7	6993.26	W I
0.8	6949.55	Tm	1.0	6975.91	Zr I	2.0	6993.40	Sm II
4	6950.29	Dy II	1.4	6976.35	Gd II	0.4	6994.08	W I
2.5 h	6950.31	Y I	2.0	6976.7	Ho II	8	6994.32	Zr I
5 cw	6950.39	Ho I	0.8 h	6976.71	Tm	0.9	6994.38	Ho
5	6950.51	Sm II	1.0	6976.86	La I	9 d	6995.22	Ta I
5	6951.26	Ta I	1.2	6978.27	Gd II		6995.49	Ta I
1.6	6951.49	Dy I	3.0 h	6978.48	Cr I	1.8 h	6995.27	Nd I
1.0	6951.68	Y II	1.2	6978.71	Mo I	0.8 c	6996.11	Nb I
2.0	6951.87	Er I	0.3	6978.86	Fe I	3.0	6996.63	Ti I
0.7 h	6952.51	La II	2.0	6979.15	Rh I	7	6996.76	Gd II
1.0	6952.95	Th II	1.8	6979.59	Hf I	1.2 b	6996.89	La LaO

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7	6998.10	Dy I	1.0	7023.48	Nb I	2.0	7049.15	Sm II
0.9	6999.13	Mo I	7	7023.67	La I	1.8 h	7049.73	Ce I
2.0	6999.87	Yb II	8 cw	7024.15	Re I	1.8	7050.65	Ti I
0.6	6999.88	Mo I	3.5	7024.58	Nd	2.0	7051.00	Gd II
2.5	6999.92	Ce I	1.2	7024.59	Pr	0.9	7051.06	Pr
1.6	7000.21	Ta I	4	7025.03	Ta I	14	7051.52	Sm II
1.4 h	7000.71	Ho	0.6	7025.32	Mo I	1.4	7052.16	Nd
2.0	7000.75	Gd II	0.6bl	7025.72	Sc ScO	1.0	7052.79	Gd I
3.0	7000.80	Th I	1.8	7026.07	V I	5	7052.89	Co I
2.5	7001.44	Er I	10	7027.40	Zr I	3.0	7052.94	Y I
2.0	7001.58	Rh I	0.9	7027.81	Co I	2.5	7053.62	Th II
1.2	7001.60	Mo I	3.0	7027.98	Ru I	1.2	7054.04	Co I
2.0	7004.66	Ti I	0.3	7028.68	W	1.4 h	7054.28	Y I
3.0	7005.07	Ta I	0.9 h	7029.38	Tm	2.0	7054.50	Ce
1.0	7005.46	Zr I	0.8	7030.33	Hf II	5 bl	7054.51	Ti TiO
0.8	7005.99	Tb II	1.2	7030.69	U	1.8	7054.62	Gd II
5	7006.16	Gd II	2.0	7031.04	Ce I	1.4	7054.72	Nd
4 cw	7006.63	Re I	4	7031.24	Lu I	1.2 b	7054.80	La LaO
6	7006.96	Ta I	1.0	7031.51	Ta I	2.5	7054.97	Sm II
1.8	7008.35	Ti I	2.5	7032.05	La I	5	7055.95	Dy II
1.4 h	7008.97	Y I	2.0	7033.21	Nd	1.4	7056.44	Tm
1.0	7009.93	Y I	2.5	7033.84	U I	2.5	7057.36	Zr I
3.5 h	7010.80	Nd	1.8	7034.32	Tm	1.4	7057.96	Zr I
0.7	7010.81	Tm	0.9	7035.13	Hf I	1.4	7058.02	Gd II
1.8	7010.94	Ti I	2.0 h	7035.18	Y I	1.4	7058.52	Er I
1.2 b	7011.22	La LaO	1.0 b	7035.77	Sc ScO	1.8	7058.68	Ce
1.0	7013.36	Ce	1.8 h	7035.86	Ti I	140	7059.94	Ba I
0.9 h	7014.33	Tm	1.2	7036.28	Th I	1.8	7060.01	Ce
0.5 h	7014.66	Dy II	0.5 h	7036.38	Dy I	2.0	7060.21	Mo I
1.0	7014.80	Ce	2.0	7036.73	Sm II	1.0	7060.66	Th II
1.2	7015.72	U I	3.0	7037.26	Gd II	2.0	7060.67	Os I
0.8	7016.44	Mo I	7	7037.30	Nd	0.7	7060.99	Tm I
1.2	7016.44	Pd I	1.0	7037.61	Dy I	1.4	7061.48	Nd
1.4	7016.60	Gd I	2.0	7037.98	Mo I	6	7061.75	Ce
2.0	7016.61	Co I	0.8	7038.04	Nb I	1.4	7061.90	Hf I
1.2	7017.24	Ce I	1.8	7038.76	Rh I	1.4 h	7062.33	Dy I
3.0	7017.43	Dy I	5	7038.80	Ti I	1.8	7062.87	Hf I
1.0	7017.73	Gd II	3.0	7039.07	Ta I	1.2	7063.34	Mo I
1.4	7017.90	Tm	14	7039.22	Sm II	0.6	7063.69	V I
0.7	7017.91	W	20	7040.20	Eu I	20	7063.83	Hf I
0.6	7018.43	Mo I	2.5 b	7040.84	La LaO	1.0	7064.45	Th I
1.6	7018.57	Th I	14	7042.24	Sm II	1.8	7064.50	Ce
1.2	7018.75	Ce I	1.6	7042.54	Pr	1.4 h	7065.00	Er I
1.6	7018.85	Nd	1.0	7043.80	Yb II	15	7066.23	La II
0.8	7019.25	Hf I	1.0	7044.60	Pr	0.4	7066.41	Nb I
14	7020.44	Sm II	1.0	7045.02	Gd II	8	7066.89	Nd
3.0	7020.71	U	0.8 h	7045.29	Mo I	1.4	7068.09	Gd II
3.5	7020.92	Nd	5	7045.80	Th II	6	7068.37	La I
0.8	7021.27	Th I	10	7045.96	La I	3.0	7069.11	Ti I
5	7021.54	Pr II	9 c	7046.81	Nb I	1.2	7069.84	Mn I

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1.0	7069.93	Gd II	1.8	7093.02	Ta I	1.8	7113.52	Zr I
55	7070.10	Sr I	0.7	7093.90	Gd I	0.9	7113.56	Co I
2.0bl	7070.79	La LaO	3.5 h	7093.98	Nd I	2.0	7113.73	Pt I
1.2	7070.96	Er II	0.6 b	7094.38	Sc ScO	2.5	7114.55	Pr
2.5	7071.00	Gd I	1.4 h	7094.40	Hf I	1.8	7115.08	Ce II
3.0	7072.05	Ti	3.5	7094.46	Zr I	4	7115.96	Sm I
0.6 b	7072.37	Sc ScO	1.4 c	7095.28	Pr	1.4 h	7116.77	Gd II
1.0	7072.39	Th I	4 h	7095.42	Nd	1.0 h	7116.8	La II
1.2	7073.61	U	5	7095.50	Sm I	1.2 h	7116.88	Pr
2.5	7073.63	Gd I	5	7095.59	Zr I	3.5	7117.51	Sm II
2.0	7074.54	Eu I	2.5	7096.33	Sm I	1.2 c	7117.52	Ta I
3.0	7074.67	Sm I	2.5 c	7096.34	Lu I	1.4	7118.19	Pr
5	7074.81	U I	55	7097.70	Zr I	3.0	7118.86	Gd II
0.9	7075.13	Y I	2.0	7098.11	Gd I	0.9	7119.31	Nb I
3.5	7075.15	Dy II	0.3	7098.22	W I	7	7119.52	Hf I
0.4	7075.23	Nb I	1.2	7098.58	Ho	4 h	7119.81	Sm II
4	7075.33	Th II	2.0	7098.73	Gd I	19	7120.33	Ba I
1.2	7076.38	La I	1.8 c	7098.94	Nb I	1.2	7120.84	Ce
55	7077.10	Eu II	0.8	7099.44	Gd I	1.6	7120.93	Dy II
1.0	7079.07	Ho	1.6	7100.52	Th II	1.6	7121.27	Ta I
0.9	7079.80	Tm	1.8	7100.54	Hf I	1.4	7121.31	Dy I
1.2	7080.02	Pr	0.5 h	7100.61	Dy II	4	7122.20	Ni I
1.2	7081.22	Mo I	1.0	7100.71	Gd I	1.8	7122.40	Sm II
1.2 h	7081.30	Ta I	2.5bl	7101.02	La LaO	5	7122.57	Gd I
2.5	7082.11	U	2.0	7101.23	Er I	0.7	7122.65	Mo I
14	7082.37	Sm II	6	7101.63	U I	0.7	7122.95	Nb I
1.6	7082.85	Tb II	3.0	7101.64	Rh I	1.0	7123.46	Ce
1.6	7082.92	Nd	0.7	7101.70	Dy II	1.8	7124.56	Th I
5	7084.17	Th I	0.5	7101.73	Gd II	1.6	7124.73	Ce
0.7	7084.18	Gd I, II	0.8cw	7102.01	Nb I	4 b	7124.9	Ti TiO
11	7084.99	Co I	0.5	7102.58	V I	3.5 h	7125.11	Sm II
2.0bl	7085.40	La LaO	0.8	7102.65	Mo I	5 bl	7125.61	Ti TiO
1.6	7085.40	Ta I	28	7102.91	Zr I	3.0	7125.72	Ta I
1.0	7085.52	Gd II	17	7103.72	Zr I	8	7125.84	Lu II
6 d	7085.52	Sm II	2.5	7104.45	Rh I	1.6	7126.17	Nb I
1.0	7086.06	Ru I	5	7104.54	Sm I	1.2	7127.92	Y I
6	7086.36	Ce	1.8	7105.04	Ce	7	7128.91	U I
14	7087.30	Zr I	1.4	7106.14	Tm	6	7129.35	Nd
1.4	7087.35	Ru I	3.0	7106.23	Sm I	0.8	7130.06	Nb I
6 bl	7087.89	Ti TiO	17	7106.48	Eu I	1.0 h	7130.09	U I
4	7088.30	Sm I	0.6	7108.05	Ta I	0.6	7130.29	Th I
1.0	7089.22	Tb II	2.5	7109.30	Dy II	0.6	7130.94	Fe I
4	7089.34	Th II	0.9	7109.60	Er I	0.9	7131.36	Th I
2.5	7089.43	Zr I	10	7109.87	Mo I	1.8bl	7131.58	La LaO
2.5 h	7089.84	Nd	0.8	7110.90	Ni I	2.0	7131.80	Sm I
2.5	7091.16	Sm I	0.4 h	7111.18	W I	70	7131.81	Hf I
0.9 h	7092.08	V I	14	7111.68	Zr I	1.2	7132.06	Ce
2.5 h	7092.09	Nd	1.0	7112.69	Tb II	1.2	7132.95	Zr I
2.5 h	7092.74	Nd	4	7112.82	Zr I	1.2	7133.16	Gd II
2.5 h	7092.94	Nd	1.2	7113.15	Ce	2.5	7134.08	Mo I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
0.8	7134.32	Co I	0.9 h	7156.51	Dy I	1.0	7186.21	Ce
1.8	7135.73	Gd II	0.8	7156.94	Th I	2.0	7187.34	Fe I
1.6	7136.01	Sm I	2.5	7156.99	Ce	0.9	7187.48	Tb II
1.2	7136.08	Ce	4 h	7158.08	La I	2.0	7189.02	Nd
0.9	7137.28	Pr	1.8	7158.28	Gd I	2.5	7189.40	Ce II
1.6 h	7138.14	Sc I	1.4hs	7158.56	Th	5	7189.42	Nd I
0.8	7138.28	Zr I	3.0hs	7159.10	Th	4	7189.57	Gd II
3.5	7138.91	Ti I	1.0	7159.18	Co I	1.6	7189.57	Sm II
1.8	7139.39	Sm II	6	7159.43	Nb I	7	7189.89	Ti I
0.8	7140.45	Th II	1.2 h	7159.87	Pr	0.9 h	7189.96	Pr
1.4	7140.54	W I	0.9	7159.93	Th I	7	7191.14	Th II
1.6	7140.74	Zr I	5	7161.25	La I	1.0	7191.35	Ta I
0.8 h	7141.17	Gd II	0.6	7161.89	Er I	0.8	7191.37	Nb I
2.5	7141.42	Ce	1.0	7162.60	La LaO	0.5 h	7191.37	W I
0.4	7141.52	Dy II	0.8	7162.66	W I	0.8	7191.49	Gd II
1.2	7141.68	Ce	0.8	7164.30	Gd II	3.5	7191.66	Y I
0.4	7141.72	Ru I	0.8	7164.47	Fe I	1.6	7191.72	Ce I
2.5 h	7142.04	Nd	1.0	7164.66	Eu I	4	7192.01	Nd I
1.0	7142.55	Rh I	2.0	7164.87	U I	0.5	7193.60	Co I
1.6	7142.79	Lu I	1.2hs	7164.88	Th	2.0	7194.63	U
1.2	7143.10	Lu I	1.4	7165.94	Lu II	95	7194.81	Eu II
2.0	7143.72	Nd	3.5	7167.13	Ti	6	7195.24	Ba I
6 d	7143.98	Sm II	2.5 h	7167.24	Sr I	0.9 h	7195.89	Tb II
1.2	7144.47	Zr I	0.9	7167.75	Pr	1.0 h	7195.93	Y I
3.0	7145.54	Os I	24	7168.37	Gd I	1.0	7196.66	U
0.9	7146.13	Gd II	5	7168.90	Th I	1.6 h	7196.99	Er I
2.5	7147.31	Gd II	60	7169.09	Zr I	0.8	7197.02	Ni I
3.5	7147.89	U I	1.8	7169.13	Sc I	1.8	7197.08	Gd II
19	7148.15	Ca I	3.0	7171.53	Ti	0.5	7198.62	W I
2.0	7148.15	V I	1.0	7172.10	U I	0.8 h	7198.63	Gd I
0.8	7148.55	Th I	3.0	7172.26	Gd II	0.4 h	7198.75	Dy I
12	7148.63	Ta I	1.6	7172.67	Sm I	2.0	7198.83	Nd I
0.7	7149.31	Dy II	9	7172.90	Ta I	1.2	7200.04	Th I
13 d	7149.60	Sm II	1.2	7173.37	Th I	1.0	7200.18	W I
1.0	7149.77	La I	0.6	7173.40	Gd II	1.8	7201.41	Gd II
1.4	7149.89	Os I	1.0 c	7174.91	Ta I	1.8	7201.54	Ce
3.0	7150.23	Ce II	1.2	7174.98	Ce	5	7201.62	Zr I
0.9	7150.28	Th I	2.0	7175.16	Dy II	2.5	7201.87	Ce
0.8	7150.77	Gd I	5	7175.55	Eu I	9	7202.19	Ca I
1.6	7151.03	Nd	0.9	7176.72	Th II	1.6	7203.52	Ce
0.6	7151.36	V I	1.2	7177.43	Ce	3.5 b	7203.64	Ti TiO
1.6	7151.67	Ce	1.0	7182.00	Ni I	6	7204.28	Tb II
1.2	7153.09	Nd	0.6	7182.08	V I	1.0	7205.45	U I
0.6	7153.09	Sr I	1.2	7182.29	Ce	1.4	7206.33	Os I
0.6	7153.58	Ba I	2.0	7183.47	U	0.8	7206.48	Th I
1.0	7154.71	Co I	0.7	7183.71	Ir I	0.4 h	7206.89	Dy I
1.6hw	7154.94	Th I	0.6	7184.10	Os I	1.2	7207.41	Fe I
2.5	7155.24	Ce	1.0	7184.25	Mn I	6	7208.01	Th I
1.2	7155.37	Er II	1.2 h	7185.01	Nd	1.2 c	7208.81	Pr
2.5hs	7155.38	Th	0.7	7185.52	Cr I	0.9 c	7208.94	Nb I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
34	7209.44 Ti I		0.7	7240.46 Mo I		2.5 b	7269.05 Ti TiO	
0.7	7209.96 Os I		50	7240.87 Hf I		2.5	7270.09 La I	
1.6	7210.29 U I		9	7240.90 Sm II		1.0	7270.30 La I	
2.0	7210.66 Ce		2.0	7241.66 Ce CeO		6	7270.82 Rh I	
1.4	7210.95 Sm I		0.9	7242.08 Ho I		2.0	7271.94 Rh I	
1.8	7212.69 Th I		0.9	7242.24 Gd II		0.5	7272.29 Ta I	
1.6	7213.32 Dy I		14	7242.50 Mo I		2.5	7272.62 Tm	
3.5	7213.82 Sm I		0.9 c	7243.24 Pr		0.8	7273.03 Rh I	
0.9	7213.90 Ce		0.9 h	7244.47 Yb I		1.2	7273.60 Dy II	
8	7216.20 Ti I		0.8	7244.69 Th I		0.5	7274.49 W	
0.5	7216.31 W I		17	7244.86 Ti I		0.7	7274.81 Nb I	
3.0	7217.34 Ce		3.5	7245.85 Mo I		1.0	7275.57 Sc I	
95	7217.55 Eu II		8 cw	7246.67 Re I		2.5	7276.96 Ta I	
1.6	7217.75 Th II		0.8	7247.82 Mn I		0.4	7277.54 Ta I	
1.6	7218.04 U		2.0	7250.04 Dy I		1.8 h	7277.91 Ce I	
1.8	7218.05 Th I		2.5 h	7250.27 Ta I		0.9	7278.23 W I	
4 d	7218.09 Sm II		0.9	7250.60 Ho I		2.0	7279.25 Sm I	
1.6	7219.06 Rh I		1.2	7251.16 Os I		1.0	7279.94 Ce	
0.7	7219.15 Th I		17	7251.72 Ti I		0.4	7279.97 Dy I	
0.7	7219.26 Ru I		2.5	7252.35 Nb I		3.5hl	7280.00 Rb I	
2.0	7219.91 La I		2.0	7252.70 Gd II		95	7280.30 Ba I	
2.0	7220.07 Sm I		4	7252.72 Ce I		4	7281.47 Sm II	
0.4	7222.62 Dy I		0.8	7253.49 Os I		1.8 h	7281.53 Eu I	
0.4	7223.00 Dy I		3.5	7254.47 U		0.6	7281.53 Mo I	
1.8 h	7224.68 Eu I		1.4	7257.11 Sm II		1.2	7282.21 Sm I	
0.4	7226.05 W I		1.0 b	7257.16 La LaO		10 cw	7282.34 La II	
1.6 h	7227.01 Nd		1.6	7257.57 Sc I		3.0	7283.33 Sm II	
3.0	7227.71 Pr		0.6	7257.71 Tm		2.0 h	7283.82 Mn I	
1.4	7228.02 Gd I		3.5	7257.73 Tb I		0.8 h	7284.03 Er	
2.0	7228.84 Ba I		1.2	7258.17 Zr I		1.2	7284.31 Tm	
14	7229.00 Pb I		2.5	7258.72 Eu I		0.8	7284.69 Zr I	
2.5 h	7230.11 Dy I		0.9 c	7259.22 Pr		1.2	7284.90 Th I	
0.8	7230.86 Th I		1.4 d	7261.45 Sm II		0.7	7285.28 Co I	
0.7 h	7231.32 Tm		1.4 h	7261.64 Nd II		1.8	7285.29 Nd II	
1.6	7231.49 Pr		1.0	7261.76 Dy I		0.8	7285.62 Th	
2.0	7232.27 Sr I		0.8	7261.93 Ni I		1.4	7285.80 W I	
3.5	7233.45 Gd I		0.7	7262.62 Hf I		1.6 h	7286.15 Tm	
0.6	7233.45 Ta I		2.0	7262.64 Ce		0.7	7286.36 Ta I	
0.8	7233.74 Tm		4	7262.66 Gd I		1.2	7287.05 Th I	
0.6 h	7234.72 Dy II		5	7262.77 Eu I		0.9 c	7287.71 Pr	
1.8 h	7234.98 Tb I		2.5	7263.40 Ti		1.4	7288.26 Dy II	
2.5	7235.69 Ce CeO		3.5	7264.17 Y II		1.8	7288.56 Nd II	
0.6 h	7236.20 Cr I		1.2	7264.29 V I		2.5	7288.92 Sm II	
3.0	7236.52 Nd		3.5	7264.76 Zr I		1.8hs	7288.97 Th	
2.0	7237.02 Sm II		0.9 h	7264.82 Ta I		0.9 h	7289.14 Pr	
0.7	7237.08 W I		0.8 h	7264.96 Er II		2.0	7290.23 Sm I	
80	7237.10 Hf I		2.5	7266.29 Ti I		2.0	7291.35 Gd I	
2.5ch	7237.98 Lu I		0.8	7266.96 Ru I		1.2	7291.38 Nd	
3.5	7238.36 Ce II		2.0	7267.62 Mo I		0.7	7291.45 Ni I	
4.0	7238.92 Ru I		3.0	7268.18 Rh I		1.6cw	7292.72 Re I	

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
0.9 h	7293.08	Y I	0.9cw	7324.36	Pr	0.4 h	7354.42	Dy II
1.8	7296.16	Ce	1.2	7324.81	Th I	0.8	7354.59	Co I
1.0 c	7296.32	Ta I	2.5	7324.89	Gd II	2.0	7355.34	Er
1.4	7296.58	W I	1.0	7325.95	Ta I	9	7355.90	Cr I
1.0 h	7297.56	Eu I	6 h	7326.15	Ca I	0.7	7356.10	Hf I
0.3	7298.23	W	4.0	7326.51	Mn I	1.2	7356.40	Er
1.4	7298.77	Nd	1.2	7327.07	Gd I	3.0	7356.54	V I
1.6	7300.19	Mo I	2.0	7327.08	Sm II	0.6	7356.65	Eu I
0.4 h	7300.31	Dy I	1.0	7327.82	Zr I	8	7356.96	Ta I
0.4 h	7300.62	Sc I	1.2	7328.28	Th I	1.2	7357.16	Nd
4 h	7300.72	Sm II	1.4cw	7328.38	Nb I	12	7357.74	Ti I
90	7301.17	Eu II	0.9	7328.47	Pr	1.0 h	7358.35	Th II
0.6	7301.22	Gd II	1.6	7329.79	Er II	0.9	7358.66	V I
3.0	7301.43	Ce	4	7329.92	Ce	0.5	7360.38	Mo I
11	7301.74	Ta I	0.9 h	7330.62	Y	2.0	7361.39	V I
3.0 h	7302.89	Mn I	2.5	7330.67	Ce	0.7	7361.58	Dy II
0.8 h	7305.25	Yb I	2.0	7332.65	Sm I	1.2	7361.65	Mo I
1.8	7305.40	Th II	0.5	7332.96	Y II	1.0 h	7361.89	Ce II
2.0	7306.21	Zr I	0.7	7333.71	Mo I	1.8	7362.25	Eu I
0.6 h	7307.32	Zr I	10 cw	7334.18	La I	1.0	7362.42	Ce
1.4	7308.55	Ho	1.2	7334.56	Nd I	1.0	7362.49	V I
25	7309.41	Sr I	1.2	7335.57	Th II	1.0	7363.12	Ce
1.4 h	7310.06	Pd I	5	7335.97	Zr I	2.0	7363.16	V I
1.8	7310.46	Eu I	9 cw	7336.18	Eu I	8	7364.11	Ti I
2.0	7310.51	Tm	1.6	7336.73	Tm	0.9 h	7364.41	Mo I
1.6	7311.57	Tb II	1.2	7338.04	Sm I	0.7	7365.25	Mo I
2.5	7311.62	Zr I	3.5	7338.92	V I	0.7	7365.28	Hf I
1.0 h	7313.10	Yb I	0.9cw	7340.19	Ta I	8	7368.12	Pd I
3.0	7313.28	Gd I	1.4	7341.15	Th I	7 cw	7369.09	Ta I
3.0	7313.45	Ce	2.5	7341.43	Ho	9 cw	7369.60	Eu I
2.0	7313.63	Eu I	0.8	7342.58	Th I	120	7370.22	Eu II
3.5	7313.72	Zr I	2.0	7343.45	Ce	1.6	7370.26	Dy II
0.3 h	7314.74	Dy II	5	7343.96	Zr I	1.0	7371.95	U I
2.0	7315.56	Ti I	16	7344.72	Ti I	9 cw	7372.50	Nb I
2.5	7316.80	Nd	0.9	7344.86	Pr	1.0	7372.53	Ce
0.6	7317.03	Nb I	2.5	7345.18	Dy II	2.0	7373.50	Zr I
9	7318.08	Zr I	6	7345.34	La I	2.0	7373.81	Gd I
3.5	7318.39	Ti I	1.0	7345.63	Ce	1.2	7374.04	Nd
1.6	7319.84	Ta I	0.6	7346.25	Eu I	0.8	7374.80	Zr I
9	7320.05	Hf I	0.9	7346.34	Th II	0.8	7375.07	Os I
1.0	7320.91	La I	13	7346.41	Ta I	1.6	7375.57	Rh I
1.4 h	7321.43	Nd	5	7346.46	Y I	3.0	7376.06	Dy I
0.7	7321.44	V I	4	7347.30	Sm I	2.0	7376.41	Gd I
2.0	7321.76	Hf I	1.2	7348.49	Mo I	4	7376.69	Sm II
0.7	7322.25	Mo I	4	7348.88	Tb II	1.4	7376.88	Th I
0.9 c	7322.72	Ta I	0.4	7349.66	Dy I	1.8	7377.27	Gd II
0.7	7322.79	Mo I	1.6 h	7350.09	Yb I	0.9	7377.77	Gd I
1.4	7323.10	Nd	1.4	7352.16	Ti I	3.0	7379.70	U II
0.9	7323.56	Ru I	11 c	7352.86	Ta I	5 bl	7379.71	La LaO
0.8 c	7323.92	Nb I	3.0 c	7353.16	Nb I	8 bl	7380.08	La LaO

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
1.8	7380.28 Gd I	13	7407.89 Ta I	0.7	7439.96 Tm	
1.4	7381.60 Dy I	1.2	7407.95 Os I	1.8	7440.17 Ta I
1.4	7381.81 Nd	5	7408.17 Rb I	1.0	7440.49 Ce	
3.5	7382.73 La I	2.5	7409.35 Ni I	3.5	7440.60 Ti I
2.5	7383.63 Zr I	0.8	7409.70 Lu II	2.0 c	7441.52 Lu I
1.2	7383.71 Th I	0.7	7411.18 Fe I	5	7441.85 Gd I
1.0	7383.72 Ce	1.2	7411.20 Nd	3.0 h	7442.39 Rh I
0.6	7385.08 W I	5 b	7411.34 La LaO	3.0 b	7442.92 La LaO
0.6	7385.24 Ni I	1.0	7411.39 Zr I	2.0	7444.44 Ce	
3.0	7385.50 Th I	3.5	7412.42 Dy I	5	7444.56 Sm I
0.8	7385.95 V I	0.8	7414.51 Ni I	4	7445.41 Sm I
1.2	7385.97 Gd II	1.0	7416.57 U	1.4	7445.78 Fe I
0.8 h	7386.64 Rh I	1.8	7417.38 Co I	1.2	7446.77 Rh I
0.6	7387.36 Eu I	2.0	7417.53 Ba I	1.2	7447.34 Mo I
1.2	7388.70 Co I	0.8 h	7417.89 Zr I	0.7	7447.84 Th I
2.0	7389.16 Eu I	2.0	7417.94 Ce	2.5	7448.33 Yb I
1.8	7389.40 Ho	2.0	7418.18 Nd	1.8	7448.76 Nd	
0.6	7389.42 Fe I	0.6	7419.83 Nb I	3.0	7450.30 Y II
1.4	7390.45 Ce II	1.0	7421.00 Ce	1.4	7451.08 Dy II
2.5	7390.70 Hf I	3.5	7422.28 Ni I	0.4	7451.40 W	
1.0	7390.99 U	1.0	7422.75 Zr I	2.5 c	7451.71 Pr	
3.5	7391.36 Mo I	0.7	7423.69 Hf I	1.2 h	7452.85 Mo I
3.0	7391.92 Pd I	1.4 h	7424.24 Tb II	4 d	7453.03 Sm II
1.0	7392.11 U	1.8	7424.70 Ce CeO	2.5	7454.03 U	
11	7392.41 Ba I	5	7425.50 U I	0.3	7456.34 W	
1.0	7393.40 Ce	50	7426.57 Eu II	1.4	7456.96 Lu II
0.5	7393.44 Th I	8	7426.99 Dy II	3.0	7457.05 Dy II
0.5 h	7393.49 V	1.8	7427.41 Nd	1.2	7457.36 Co I
2.5	7393.60 Ni I	0.8 h	7428.62 Dy I	1.0 h	7458.40 Ce	
1.8	7393.93 Ru I	2.0	7428.65 Er	6	7459.53 Er I
2.0	7393.98 Sm II	3.5	7428.94 Th I	3.0hl	7459.78 Ba I
1.8	7394.90 Gd II	0.9 h	7429.62 Tb II	0.5 h	7459.97 Dy I
3.0	7396.99 U I	1.8	7430.19 Gd I	1.0	7460.42 Er	
4	7397.76 Ce I	1.6	7430.25 Th I	1.4	7462.31 Ce	
0.9	7398.27 Tb II	1.6	7430.80 Rh I	16	7462.31 Cr I
1.2 h	7398.77 Y I	2.0	7432.19 Tm	5 h	7463.08 La I
0.8 h	7399.30 Zr I	0.6	7432.57 Gd II	1.6	7463.86 Hf I
14	7400.21 Cr I	2.0	7433.08 Ce	6	7464.36 Gd I
1.4	7400.90 Zr I	1.0	7433.10 Zr I	5 bl	7465.25 La LaO
1.8	7401.26 Ce	0.9	7434.10 Mo I	9 bl	7465.48 La LaO
1.8	7401.31 Nd I	6 bl	7434.28 La LaO	1.8	7467.57 Zr I
0.9	7402.24 Th I	10 bl	7434.36 La LaO	2.5	7467.75 Ta I
1.4 h	7403.17 Dy I	0.7	7434.46 Gd I	2.0	7468.91 Ru I
10 bl	7403.52 La LaO	0.8	7434.51 Tm	13	7469.46 Er I
20 bl	7403.75 La LaO	0.9 c	7435.19 Ta I	1.4	7470.53 Eu I
0.4	7403.99 Dy I	0.7	7436.02 Nb I	2.0	7470.76 Sm I
1.8 h	7404.41 Eu I	3.5 h	7436.59 Eu I	0.8	7472.15 Tb I
2.0	7406.62 Nd	3.0	7437.56 Hf I	1.6	7472.41 Ce	
2.0	7407.60 Pr	1.8	7438.58 Ce	1.2	7474.94 Ti I
1.6	7407.62 Dy I	11	7439.86 Zr I	1.4	7475.40 Ru I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
0.6	7475.43	Mo I	1.4 h	7507.31	Tm	0.7 h	7536.71	Y I
2.0	7475.74	Rh I	1.0	7508.16	Ce I	0.8	7537.43	W I
0.9	7478.20	Nb I	0.9	7508.99	W I	2.0	7538.27	Nd
1.0	7478.69	Ce	1.4 h	7509.43	Ce I	0.7 h	7539.14	Er
1.6	7479.58	Zr I	0.5	7509.59	Dy I	8	7539.23	La I
11	7481.09	Tm I	1.0	7510.08	U	1.4	7539.53	Ce
1.6	7481.35	Th I	1.0 h	7510.74	Ho I	2.0 h	7540.62	Zr I
1.0	7481.37	Nd I	6	7510.75	Au I	1.0	7540.98	Nd
4	7481.99	Sm II	3.0	7511.04	Fe I	1.8	7541.02	Pr
1.0	7483.01	Dy I	2.5	7511.16	Nd	3.5 h	7541.42	Sm II
0.7	7483.35	W I	1.2	7511.34	Th II	1.4	7542.02	Rh I
7 cw	7483.50	La II	2.5	7511.40	Tb II	8	7543.76	Dy I
2.0	7484.54	Tb II	3.5	7513.77	Nd II	2.0	7544.59	Zr I
0.8	7484.56	Hf I	1.4 h	7514.44	Nd	1.4	7544.74	Sm I
13	7485.74	Mo I	1.4 h	7515.70	Zr I	2.0	7545.78	Tm
3.0	7485.79	Ru I	3.0	7515.93	Nb I	1.6	7546.57	Sm I
1.0 h	7485.90	V I	1.4	7516.01	Nd	1.4	7547.00	Nd I
1.8	7486.01	Ta I	2.5	7516.59	Dy II	1.0	7547.32	Eu I
2.5	7486.55	Ce	1.6 h	7517.00	Sm II	1.2	7549.31	Th I
1.8	7486.90	Pd I	1.0	7517.41	U	2.5	7550.23	U
17	7488.08	Ba I	1.2	7517.95	Zr I	0.8	7550.46	W I
1.0 h	7488.08	V I	1.4 c	7519.77	Nb I	1.6	7551.24	Ce
0.8	7489.44	Gd II	0.8	7519.77	Tb II	3.0	7551.46	Zr I
3.5	7489.61	Ti I	2.5	7520.56	Ta I	0.7 h	7553.00	Zr I
11	7490.22	Tm I	0.3	7520.66	W I	2.5 h	7553.03	Dy I
0.9 h	7491.00	Eu I	0.9 h	7521.03	Zr I	1.8 h	7553.96	Sc I
1.0 h	7492.44	V	2.0	7522.76	Ni I	1.0	7553.99	Co I
1.8	7494.88	Y I	1.6 h	7524.13	Sc I	4	7554.70	Zr I
1.8	7495.09	Fe I	1.4	7525.12	Ni I	14	7555.09	Ho I
2.0	7495.24	Rh I	8	7525.51	Th II	3.0	7555.60	Ni I
0.8	7495.45	Tb I	1.8	7526.49	Nd	3.0	7556.24	Er I
1.4 h	7495.62	Pr	1.8	7527.44	Ce	1.8	7556.37	Hf I
4	7496.12	Tb I	3.0 h	7527.56	Yb I	0.6	7557.59	Tb II
2.5	7496.12	Ti I	1.8	7527.68	Ce	1.8	7557.67	Rh I
0.5 h	7496.20	Ho	1.8bl	7528.21	La LaO	0.8 h	7557.81	Dy I
4 bl	7496.50	La LaO	5 bl	7528.39	La LaO	20	7558.35	Tm I
9 bl	7496.78	La LaO	0.7	7528.48	Th	2.5	7558.45	Zr I
5	7498.83	La I	8 cw	7528.70	Eu I	3.0	7559.61	Ru I
0.8 h	7499.45	Pr	2.0	7528.70	U	4	7559.81	Dy I
1.6	7499.69	Tb II	2.5	7529.01	Nd	3.5bl	7560.09	La LaO
8	7499.75	Ru I	0.5	7531.17	Fe I	1.2	7560.09	Zr I
1.4	7500.68	Ce	0.8	7532.07	Ru I	1.8 h	7560.15	Sm II
0.5	7501.62	Mo I	2.5	7532.32	Er	0.7	7560.31	Zr I
3.5 h	7502.39	Sm II	0.9 h	7533.02	Eu I	1.2	7562.12	Zr I
0.9	7502.92	Zr I	1.0 h	7533.14	Dy I	2.0	7562.44	Ce I
0.6	7504.16	W I	0.4	7533.48	Co I	1.6	7562.86	Ce
1.2	7504.47	Mo I	3.0	7533.59	La I	9	7562.93	Hf I
0.8	7505.35	Gd II	1.6	7533.70	Ce	3.0	7562.94	Sm II
0.9	7506.51	Zr I	10	7533.91	U I	6	7562.96	Dy II
3.0 b	7506.79	La LaO	0.8	7536.41	Th II	8	7562.97	Gd I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
3.5	7563.13	Y I	4	7590.24	Tb I	1.8 h	7612.94	La II
1.4	7563.19	Gd II	0.6 h	7590.44	Er	0.6	7612.94	Ru I
1.6 h	7563.52	Ce I	1.2	7590.49	Nd	1.2	7613.48	Er I
1.8	7564.22	Hf I	1.0	7590.54	U I	1.8	7613.94	Sm II
0.3	7564.96	Co I	0.4 h	7590.57	Co I	1.6	7614.11	W I
0.8	7566.10	Gd I	0.8 h	7591.24	V I	2.0	7614.50	Ti I
1.2	7566.53	Th	4 h	7591.36	Dy I	1.0	7614.69	Nd
3.0	7567.74	Th I	0.6	7591.66	Mo I	1.6	7616.01	Tb II
0.3	7568.92	Fe I	2.5	7591.87	Ho I	4	7616.10	Ce
0.5	7569.23	Ta I	3.5bl	7592.26	La LaO	0.8 h	7616.21	Dy I
1.6	7569.91	W I	1.4	7592.96	Hf I	3.5	7617.00	Ni I
3.5	7570.95	Sm II	0.9 h	7593.64	Ho I	1.2	7617.05	Ho I
0.6	7571.53	Mo I	3.0 h	7593.74	Tm	1.4	7617.45	Sc I
3.5	7572.29	Sm II	0.7 h	7594.35	Ho I	0.8 h	7617.72	Y I
1.0	7572.64	Mo I	0.8 h	7594.95	Dy I	1.6 h	7617.73	Dy I
1.2	7574.05	Ni I	2.5	7595.07	Tm	7	7618.93	Rb I
0.7 h	7574.11	Er	1.0	7595.07	U I	1.4	7619.21	Ni I
2.0 h	7574.44	Sc I	1.0 h	7595.16	Mo I	3.5	7619.35	U I
8 c	7574.58	Nb I	6	7596.44	Tb I	0.8cw	7620.25	Re I
0.7	7574.92	Pr	1.2 h	7596.92	V I	0.3	7620.54	Fe I
1.4	7576.95	Hf I	1.2	7597.26	Er	2.0	7621.17	Zr I
1.4	7577.22	Rh I	1.6	7598.01	Sm I	2.0	7621.50	Ru I
3.0 h	7577.47	Dy II	0.6	7598.20	Th II	5	7621.50	Sr I
1.0	7577.54	Nd	1.0 h	7598.28	V I	0.5	7621.61	Zr I
3.0	7578.09	Sm II	0.8	7600.27	U	1.6	7621.95	U
5 cw	7578.73	Re I	1.6 h	7601.18	Tb II	3.0	7621.96	Gd I
1.0 h	7578.75	V I	1.0	7601.84	Mo I	2.0 h	7622.94	Y I
0.6	7579.58	Mo I	1.2	7602.31	Ho II	0.7	7623.45	Er
1.6	7580.55	Ti I	3.5	7602.95	Os I	2.0 h	7624.05	Tb I
2.5 h	7580.61	Tm	1.6	7603.10	Ce	44	7624.40	Hf I
1.6	7580.91	U	1.2	7603.75	Nd II	2.0	7624.81	V I
2.5 h	7582.03	Tb II	1.6	7605.35	Ho I	1.8 b	7624.99	La LaO
0.5	7582.88	W I	1.0	7605.94	Nd	1.2	7625.70	Th I
0.8 c	7583.21	Nb I	0.8 h	7606.30	Co I	0.8	7627.16	Th I
0.4	7583.80	Fe I	0.7	7607.15	Er	3.0	7627.81	Tb I
26	7583.91	Eu I	8	7607.15	Zr I	1.4	7627.98	Ho I
4	7585.73	Th I	3.5 d	7607.48	Sm II	4 c	7628.42	Ho I
5	7585.77	Sm II		7607.74	Sm I	0.7	7629.86	Tm
1.4	7586.01	Ce	1.6	7608.59	Hf I	0.7 h	7630.30	Th I
1.0	7586.04	Fe I	4	7609.01	Cs I	0.3	7631.29	W
0.5	7586.72	Co I	2.0	7609.16	U I	2.5	7631.71	U I
2.5	7587.49	Tb II	0.6	7609.25	Dy I	1.6 h	7631.77	Sm II
0.7	7587.55	U	0.8 h	7610.24	Co I	1.2	7632.56	Ce
1.4	7587.66	Nd II	2.0	7610.48	Ba I	1.6	7634.73	U I
0.5	7587.76	Dy I	0.8	7610.83	Zr I	0.8 h	7635.29	Dy II
1.4	7588.20	Gd I	2.0 h	7611.54	Dy I	1.0hl	7636.90	Ba I
3.5	7588.31	Sm II	1.4	7611.78	Gd I	3.5	7637.94	Sm II
1.8	7589.20	Ho I	1.6	7611.89	Re I	0.8 h	7639.05	Tb II
1.2bl	7589.62	Ti TiO	1.4	7612.08	Zr I	0.8 h	7639.25	Dy I
0.7	7590.22	Ta I	0.3	7612.13	W	3.0	7639.54	U I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
1.8	7639.79	Nd	1800	7664.91	K I	0.4	7701.37	V I
0.6	7639.81	Nb I	0.5	7665.63	Er	0.6	7701.46	Os I
1.2ch	7640.08	Lu I	1.8 h	7665.72	Sc I	1.2 h	7701.46	Tm
6 cw	7640.94	Re I	1.0 h	7666.25	Tm	1.4	7702.84	Ce
0.9 c	7641.14	Ho I	1.6	7666.78	Dy II	1.2	7703.33	Nb I
5 h	7641.15	Dy I	3.0	7667.20	Sm II	1.4	7704.27	Zr I
4 hl	7642.91	Ba I	1.2 c	7667.30	Ho I	0.7	7704.81	V I
7	7645.09	Sm II	0.8	7668.73	U	0.9	7704.96	Pr
1.8 h	7645.62	Er	0.8	7669.69	U	1.4bl	7705.21	Ti TiO
2.5	7645.64	Hf I	1.2	7670.76	Ce I	2.0 h	7706.16	Tb I
2.5	7645.67	Pr	50	7672.09	Ba I	1.0	7708.42	Zr I
1.8	7645.82	Sm I	1.2	7672.49	Sm II	0.8	7709.54	Mo I
2.5	7645.87	Dy I	3.5	7672.56	Gd I	0.9	7709.57	Th II
1.6	7645.98	Nd	0.7	7672.72	Tb II	0.6	7710.27	Th I
2.0	7646.09	Ce	4 h	7673.06	Sr I	0.9	7711.93	Dy II
2.0	7646.66	Dy I	1.2	7676.04	Tm	3.5	7712.04	Sm II
5	7647.38	Th I	1.4	7676.06	Gd I	0.8	7712.42	Mn I
0.6	7647.71	Nb I	1.2	7676.22	Th II	1.8	7712.68	Co I
1.6	7647.91	Ce	1.4 h	7676.74	Dy I	2.5	7714.32	Ni I
3.0	7648.02	Sm II	1.0	7677.16	Gd I	4 cw	7715.06	Ho I
0.6	7648.12	Dy II	1.2	7678.12	Ce	5	7715.35	Dy I
0.4	7648.16	Ho I	0.6	7678.12	Th I	0.8 h	7715.58	Ni I
0.7 h	7648.78	Tm	1.6 h	7678.79	Sm II	0.6	7717.66	Gd I
0.6	7649.52	Mo I	1.2	7679.49	Mo I	0.9	7717.68	Ce
0.5	7649.62	Ta I	4	7680.00	Er I	1.2	7718.15	Nd
3.0	7650.32	Gd I	1.0	7680.20	Mn I	1.6	7719.05	Ho I
0.9	7650.58	Er	2.0	7682.48	Ce	2.0	7719.89	Y I
0.7	7652.89	Y I	1.0 h	7683.36	Gd I	2.5	7720.77	Mo I
0.5	7653.26	Mo I	3.5	7685.30	Th II	0.7 h	7721.08	Dy I
0.8	7653.61	U	32	7687.78	Ag I	2.0	7721.81	Pr
1.4 c	7653.80	Ho I	1.2	7688.94	W I	0.9 h	7722.02	Ta I
1.2	7653.83	Th	4	7689.17	Ce	1.0	7722.12	Er II
2.5	7654.43	Er II	0.5	7689.49	Y I	0.6	7722.48	Zr I
3.0	7654.44	Ti I	1.8	7690.05	Rh I	2.0	7722.87	Ru I
0.3	7654.78	W	2.0	7690.43	Ho I	0.8	7723.63	Mo I
2.5	7655.01	Tm	1.8	7690.83	Zr I	0.9	7723.95	Zr I
1.6	7655.78	Sm II	5 c	7693.15	Ho I	2.0	7724.08	Y I
1.6 h	7656.76	Mo I	0.6	7693.80	Th II	0.9 h	7724.60	Ce
1.4 h	7658.02	Er	0.5	7693.85	Dy I	0.9	7726.18	E II
0.6	7658.32	Th I	1.8	7694.45	Gd I	3.5 c	7726.68	Nb I
3.0	7658.60	Zr I	0.7 h	7694.74	Tb II	2.0 h	7726.97	Tb I
2.5	7659.23	Er I	1.6 h	7695.78	Sm I	3.0	7727.61	Ni I
0.6	7660.32	Tm	0.7	7696.50	Dy I	5	7728.56	Sm II
0.2	7661.22	Fe I	2.5	7696.61	Nd	2.4	7729.72	Sc I
1.4	7661.47	Dy I	4.0	7697.73	Sc I	7	7729.78	Dy II
12	7662.35	Dy I	0.8 h	7698.00	Y I	0.6	7729.91	Ru I
1.2 h	7663.38	Ce	900	7698.98	K I	12	7731.54	Tm I
1.2	7663.48	Nd	75	7699.49	Yb I	1.6	7731.74	Th II
0.6	7664.30	Fe I	0.4	7701.00	W I	1.6	7732.34	Ce I
2.0	7664.34	La I	1.4 h	7701.11	Th II	0.8	7732.49	Mo I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
11	7733.50	Gd I	0.5	7762.09	Er	0.5	7797.89	Ru I
0.5	7734.23	Co I	0.8	7762.95	Ce	0.9	7798.36	Th I
5	7736.26	Sm II	0.9	7763.11	Ta I	1.0	7798.40	Nd
3.0	7737.63	Tb I	13	7764.03	Pd I	3000	7800.23	Rb I
0.9	7738.09	Gd II	0.8 h	7764.72	Mn I	4	7800.44	Sc I
1.6 h	7738.98	Ho I	0.8	7765.70	Zr I	0.6	7800.74	Zr I
0.7 h	7739.38	Dy II	1.4	7766.48	Gd I	1.6	7801.54	Sm I
14	7740.17	Hf I	1.0	7766.55	Zr I	1.6 h	7802.40	U
7 h	7741.17	Sc I	0.9	7769.74	Ce	0.6	7802.52	Y I
0.8	7741.44	Ce	0.8 h	7771.06	Sc I	1.4 h	7803.32	Eu I
10 cw	7742.57	Eu I	3.0	7772.90	Rh I	2.5	7803.93	Tm I
0.6	7742.57	Th I	1.2	7773.03	Nd	0.6	7806.79	Ce
0.4	7743.27	Co I	0.3	7776.71	W	0.5	7806.82	Ru I
1.0	7743.57	Hf I	0.6 h	7778.29	Tm	0.7	7807.33	Tb II
0.7	7743.78	Ce	0.7 c	7779.67	Ta I	2.0	7808.50	Nd
0.9	7743.87	Nd	30	7780.48	Ba I	0.6	7808.94	W I
0.5	7743.95	Th II	1.0	7780.59	Fe I	5	7812.08	Dy I
12	7746.19	Eu I	0.6	7780.92	Dy I	1.8	7812.16	Y I
0.6	7746.66	Ce	1.2	7782.32	Th I	1.2	7812.69	Ce
1.2 h	7747.38	Er	1.8 h	7782.36	Tm	1.2 h	7812.75	Sm II
1.6	7748.19	U I	1.0	7784.12	W I	0.3	7813.43	Ru I
1.0	7748.28	Fe I	3.0	7784.13	U I	4	7814.55	Hf I
2.5	7748.34	Ce I	0.8	7785.04	Ce	0.6	7814.69	Dy I
0.4 h	7748.37	Gd II	2.0	7785.17	Sc I	6 cw	7815.48	Ho I
3.0	7748.89	Ni I	1.2 h	7785.66	Tm	1.2 h	7815.9	Lu I
0.9	7749.02	Nd	0.7 h	7786.11	Pr	1.6	7816.32	U I
5	7749.30	Gd I	3.0	7786.67	Pd I	1.2	7816.32	Zr I
5	7749.30	Sm II	0.3	7787.11	Nb I	3.5	7817.77	Th I
0.6	7750.14	Dy I	1.0 h	7787.22	Gd II	1.4	7818.21	Eu I
0.7 h	7750.37	Sc I	2.5	7787.80	Th II	1.4	7818.86	Nd
2.0	7750.97	Nd	1.4	7788.42	Y I	11	7819.35	Zr I
3.0	7751.61	Dy II	2.5	7788.93	Th II	2.5	7820.15	Sm II
0.8 c	7752.01	Ho I	1.6	7788.94	Ni I	1.4	7821.64	Sc I
0.4	7752.34	Mo I	1.0	7789.96	Os I	3.5	7822.94	Zr I
0.7	7752.72	Sc I	1.2	7790.05	Dy I	4 cw	7823.63	Ho I
0.7	7752.85	Ce	5	7790.90	Hf I	0.2	7823.78	W
1.6	7754.19	U I	5	7791.61	Rh I	9	7824.91	Rh I
2.5	7754.61	Er I	2.5	7791.86	Ru I	1.0	7825.20	Nd II
3.5	7755.20	Sm II	1.4	7792.24	Nd II	4	7826.72	Zr I
1.4	7755.97	Gd I	2.0	7793.20	Tb II	0.6	7829.22	Tm
1.2	7757.31	Nb I	1.6	7794.50	Sm I	1.6	7829.65	Mo I
0.8	7757.34	Dy I	1.0	7794.68	Sc I	0.5	7829.81	Ru I
11 hl	7757.65	Rb I	1.4	7796.32	Y I	2.5	7830.05	Rh I
0.6	7757.89	Hf II	1.2	7796.42	Nd II	1.6	7831.40	Sm II
1.2cw	7758.30	Lu I	1.0	7796.59	Er I	0.7	7832.05	U
2.0	7759.43	Rb I	0.9	7796.81	Hf I	1.4	7832.22	Fe I
1.6	7759.87	U I	1.6	7797.32	Nd	1.0	7832.79	Dy I
0.6	7760.07	Dy I	4	7797.42	Er I	1.5	7832.91	Tb II
0.5	7761.14	W I	2.0	7797.59	Ni I	0.6 h	7833.39	Ru I
2.5	7761.86	U I	1.6	7797.70	Ce I	1.0	7834.32	Ir I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
1.2	7834.46	Gd I	0.5	7861.76	Tm	2.5	7895.96	Sm I
1.4	7834.46	Th II	2.5	7862.84	Nd	1.0	7896.40	V
6 w	7835.08	Sm II	0.4	7863.46	W I	0.8 h	7896.50	Nd
1.0 h	7835.55	Dy II	3.0	7863.65	Sm II	1.0	7897.98	Zr I
0.5	7835.71	U	1.2	7864.32	Dy II	1.2	7897.99	Th I
1.4	7835.88	Ce	2.0	7864.51	Ce	1.2 h	7898.81	V
4	7837.27	Sm II	1.4	7864.99	Tb II	2.5	7898.96	Ce I
2.0	7837.71	U	1.2	7865.00	Dy I	2.0	7899.54	Er I
1.2	7838.17	Co I	1.2bl	7865.51	V VO	1.8	7900.32	Th II
0.6	7838.40	Ce	2.0	7865.97	Th I	1.8	7900.38	Nd
1.0	7838.70	Er I	1.6	7866.04	Ce	2.0	7900.43	U I
1.0	7838.84	Gd II	0.2	7867.03	W I	1.4	7904.29	U I
0.8 h	7839.57	Ba I	0.7	7867.73	Gd I	17	7905.75	Ba I
0.5	7840.05	Co I	1.6bl	7868.40	Th	1.0 h	7906.03	Nd
1.0 d	7840.31	Th I	3.0	7868.75	U I	1.4 h	7908.00	U I
	7840.45	Th I	2.0	7869.72	Gd I	0.6 h	7908.06	Gd II
0.8cw	7841.02	Pr	0.3	7869.90	Co I	1.6	7908.46	Zr I
0.9	7841.79	Th I	3.5	7869.99	Zr I	1.6	7908.71	Co I
1.4 h	7841.80	La I	0.3	7871.39	Co I	4	7909.36	Dy I
0.7 h	7841.90	Ru I	1.8	7871.65	Pr	0.9	7910.08	Gd I
2.0	7842.60	Ce I	1.0 h	7872.03	Nd	7 bl	7910.19	La LaO
1.6 c	7842.76	Ta I	0.6cw	7873.41	Nb I	14 bl	7910.54	La LaO
1.2	7843.95	Er I	0.8 d	7874.16	Ce	8	7911.34	Ba I
2.0	7844.71	U	0.6	7875.31	Er I	8 cw	7912.94	Re I
1.6	7844.82	Sm II	3.0	7875.38	U	0.9	7913.11	Er
1.6 h	7844.87	Gd I	1.4	7876.25	Zr I	0.6	7913.11	Tb
3.5	7844.94	Ce	2.0 b	7876.87	La LaO	1.8	7913.52	Ce
38	7845.35	Hf I	7 bl	7877.22	La LaO	4	7914.96	Sm II
1.4	7845.80	Gd I	0.8 h	7879.22	Ho I	0.7	7915.07	Pr
5	7846.35	Gd II	0.6	7879.32	Er I	5	7915.80	Pd I
2.5	7846.50	Rh I	1.6 h	7880.07	Sm II	2.5	7917.01	Nd
0.9	7846.56	Hf I	0.4	7880.34	W I	0.3	7917.44	Ni I
1.8	7847.52	Er I	0.7	7880.95	Pr	0.5	7917.62	Mo I
2.5	7847.54	Th I	9	7881.49	Ru I	0.7	7918.10	Tm
3.5	7847.80	Ru I	11	7881.90	Y II	2.0	7918.80	U I
0.6	7848.45	Th I	11	7881.94	U I	16	7920.71	Hf I
9	7849.35	Zr I	1.6	7882.18	Zr I	4	7921.78	Er I
0.7	7849.62	Th II	8	7882.37	Ta I	1.0	7923.15	Mo I
2.5	7850.02	Ce	0.6	7884.39	Gd I	0.6	7924.20	Zr I
0.7 h	7851.18	V	1.6	7885.31	Nb I	1.8	7924.43	Ru I
2.5	7851.20	Ce	0.6 h	7885.70	Tb II	2.0	7925.03	Nd
1.0	7852.17	Os I	1.0	7886.28	Th I	0.6	7926.55	Co I
1.4	7854.45	Mo I	0.5	7886.47	W I	1.6	7927.30	Ce CeO
3.0	7855.52	Y I	1.4	7886.60	Nd	8	7927.52	Tm
3.0	7855.79	Tb II	0.7	7887.74	Mo I	1.6	7927.71	Ce I
0.4	7855.85	Co I	6	7887.99	Eu I	2.5	7927.90	Tb II
6	7856.11	Tm I	0.7cw	7888.40	Pr	14	7928.14	Sm II
5	7856.93	Gd I	1.8	7890.37	Ru I	3.5	7930.25	Gd II
3.5	7857.54	Ce	6	7894.64	Ho I	16	7930.88	Tm
1.0	7859.53	Sm I	0.7	7895.12	Yb I	1.4	7931.92	Sm I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
20	7933.13	Cu I	1.4	7972.11	Ce	1.2	8008.68	Dy II
1.6	7934.48	Ce	1.2	7972.34	Ce II	1.2 h	8010.16	Tb II
0.7	7934.89	Dy I	1.2 h	7972.59	Th I	0.9	8010.53	Gd II
3.0	7937.09	Sm II	1.4	7973.14	Dy I	0.8	8010.58	Hf I
1.4	7937.17	Fe I	0.7	7974.66	U	0.7	8012.96	U I
3.5	7937.73	Er I	2.0	7975.09	U I	2.0 b	8014.43	La LaO
2.0	7937.92	V I	0.7	7975.47	U	6 bl	8014.79	La LaO
3.5	7938.06	Hf I	2.0	7976.88	U II	2.0 h	8014.79	Tm
1.2	7938.89	Nb I	0.8	7978.15	Gd I	3.0 w	8014.92	Sm II
2.0	7940.47	Zr I	8	7978.88	Ti I	0.7	8015.26	Zr I
0.8	7940.93	W I	4	7978.97	Th I	1.2	8015.47	Eu I
1.8	7941.73	Th I	1.2	7979.07	Ti I	6 hl	8015.71	Cs I
1.2 h	7942.04	Cr I	0.9	7979.09	Er	2.0	8017.18	W I
5 b	7944.61	La LaO	3.5 b	7979.34	La LaO	14	8017.92	Tm I
16	7944.61	Zr I	7 bl	7979.70	La LaO	1.2	8019.38	U I
10 bl	7944.95	La LaO	4 cw	7980.77	Re I	3.0 b	8019.48	La LaO
1.4	7945.88	Fe I	0.9	7980.95	Er	0.9	8019.82	Gd I
1500	7947.60	Rb I	0.8	7981.20	Os I	0.8 h	8020.08	Nd
1.0	7947.95	Nd	0.8	7981.23	Th II	0.5 h	8021.31	Tm
2.5	7948.12	Sm II	0.6	7981.68	Th II	0.5	8022.09	Ta I
0.6	7948.15	Ru I	3.0	7982.09	Nd II	0.6	8022.13	Co I
4	7949.17	Ti I	2.5	7982.67	Nd	0.6	8023.11	Er
2.0	7949.65	Nd	1.8	7982.80	Dy II	7	8024.84	Ti I
2.5	7950.19	Ta I	0.4	7984.35	Mo I	3.5	8025.12	Sm II
0.4	7952.07	Ta I	1.6 h	7985.94	Tm	1.4 h	8025.33	Dy I
0.9	7952.98	Er I	1.4	7986.60	Mo I	3.0	8025.42	Tb II
0.8	7953.57	Ce	2.0	7987.38	Co I	5	8025.56	Ce II
0.4	7954.76	Nb I	1.8	7987.98	Th I	3.5 w	8026.32	Sm II
1.2	7955.31	Tb I	1.4	7991.30	U I	1.6	8026.41	Nd
1.0 h	7955.38	Nd	0.9	7993.82	Gd I	6	8026.50	Ta I
8	7956.66	Zr I	30	7994.73	Hf I	0.9 h	8027.21	Dy I
0.3	7957.06	W I	4	7996.53	Ti I	0.6	8027.32	Mo I
2.5	7958.93	Nd	1.0	7998.03	Tb I	2.5 c	8027.39	V I
1.4	7959.96	U I	2.0	7998.60	U I	1.2	8028.13	V I
8	7959.98	Zr I	0.5	7998.75	Ta I	0.3	8028.34	Fe I
2.0	7961.08	Pd I	1.2	7998.93	Tb I	0.4	8029.04	Ta I
3.5 h	7961.58	Ti I	1.4	7998.97	Fe I	0.8	8029.26	Co I
0.5	7962.72	Dy I	1.0 h	7999.33	Y I	3.5	8029.91	Rh I
0.9 h	7963.25	Gd II	2.5	8000.75	Nd	0.8	8030.69	Ce
2.0	7963.63	Zr I	1.6	8001.04	Tb I	0.8	8031.43	Ce
3.0	7963.97	U	3.0 w	8001.61	Sm II	0.7	8031.80	Pr
1.4	7964.57	Er I	3.5 h	8001.89	La I	2.5	8032.03	Sm II
4	7964.83	La I	3.0 d	8002.56	Ce	1.8	8032.43	Th I
2.5	7965.69	Nd		8002.69	Ce	2.0	8034.79	U I
0.5	7966.66	Gd I	0.9 h	8003.55	Ti	1.2 h	8035.38	V
1.0	7967.84	Ru I	0.6	8004.46	Dy II	1.4	8036.04	Er I
1.6	7968.63	Dy I	16	8005.27	Zr I	1.8 h	8036.11	Rh I
0.8	7968.85	Mo I	0.9	8006.26	Gd I	0.6	8037.40	Gd I
4	7970.46	U I	3.0	8007.27	Co I	1.2	8039.08	Ta I
0.9	7971.56	Tm	1.8	8007.72	Nd I	1.0	8040.01	Ce

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
0.9	8040.01	Dy I	0.9	8075.65	Th I	1.4	8141.05	Pr
0.7	8040.10	U	1.8	8077.59	Gd I	2.5	8141.72	Nd
0.4 h	8040.10	Zr I	8 hl	8079.02	Cs I	0.5	8143.12	W
0.9	8041.29	Os I	0.8	8079.36	Ce	3.0	8143.16	Th II
1.2	8043.33	Co I	3.0	8080.32	Hf I	2.5	8143.29	Nd
2.0	8043.33	Nd I	3.0	8085.06	Tb II	0.5 h	8144.00	Gd I
5	8045.40	Rh I	1.0	8085.20	Fe I	0.6	8144.28	Dy II
1.2 h	8045.71	V	0.9	8085.22	Th I	2.5	8144.59	V I
2.5	8046.05	Zr I	7	8086.05	La I	2.5	8146.15	Gd I
0.6	8046.06	Tb I	0.4	8089.96	Gd II	2.0	8147.25	Dy I
1.2	8046.07	Fe I	1.0	8090.66	Ce	0.3	8152.11	Co I
0.6	8047.23	Dy I	40	8092.63	Cu I	0.8	8152.40	Th
0.8	8048.08	Gd I	1.2	8093.48	V I	2.0	8152.58	Zr I
6	8048.70	Sm II	0.8	8093.60	Th I	0.8	8153.45	Mo I
0.6	8050.93	Dy I	2.0	8093.96	Co I	1.4	8153.71	U I
1.6	8051.30	Nd	1.6	8094.43	Ce	0.8	8154.55	V I
3.5hc	8051.39	La I	2.0	8097.62	U	0.7	8158.54	Ta I
1.0	8051.89	V	2.0	8099.09	Nd	1.4 b	8159.02	La LaO
1.6	8053.06	Zr I	0.4	8100.11	Ta I	2.0	8159.75	Th I
0.6	8053.80	Tb I	0.7	8102.44	V I	6 c	8161.07	V I
0.6	8053.93	Ta I	0.5	8104.67	Mo I	4	8161.90	Sm II
0.6	8054.52	Th II	1.0	8108.59	V I	1.6	8163.15	Th II
0.6	8054.86	W I	0.8 h	8109.07	V I	0.5 h	8163.18	Cr I
2.0	8055.29	Zr I	1.0	8112.47	Ru I	2.5	8164.17	Tb II
0.7	8055.32	Pr	1.0	8114.28	Zr I	1.4 h	8164.97	Nd I
1.4	8055.60	U I	0.4	8116.41	Co I	0.3	8165.70	W I
2.0	8055.60	W I	10 cw	8116.80	V I	1.2	8166.47	Th I
2.0	8055.76	Zr I	1.2	8116.90	Dy II	0.6 h	8169.03	Dy II
1.4	8056.06	Co I	1.4 w	8117.16	Sm II	1.2	8169.81	Th I
3.0	8056.52	Hf I	2.0	8120.17	Zr I	1.2	8171.35	V I
6	8058.08	Zr I	2.5	8120.38	Ce I	1.0	8171.41	Ce I
0.4	8058.22	Mo I	2.0	8120.85	Nd	1.2	8171.70	Tb
0.5	8060.36	W I	2.5	8122.08	Nd	1.6	8172.49	Nd
1.8	8062.63	Th I	1.4 b	8122.20	La LaO	2.0	8173.89	Hf I
15	8063.09	Zr I	1.2cw	8122.67	Pr	3.5	8174.30	U I
1.2	8063.50	Rh I	1.2	8122.73	Th I	0.8	8175.59	Ce
1.0	8064.00	Nd	1.2	8123.79	W I	1.4	8175.85	U I
2.5	8065.16	Sm I	1.4	8125.12	Sm II	1.6 c	8178.16	Lu I
2.0	8065.47	U	1.2	8126.23	U	1.8	8179.83	Nd
0.7	8065.84	U	48	8126.52	Li I	0.6	8180.21	V I
0.3	8066.49	Co I	1.0	8128.76	Ta I	0.4 c	8180.74	Ta I
0.8 h	8066.90	Ce	6	8132.82	Pd I	0.6	8181.21	Pr
1.8	8067.31	Pr	40	8132.99	Zr I	1.4	8181.90	Er I
1.8	8067.35	Tb II	1.8	8135.20	Nb I	1.8	8182.41	Nd
4	8068.24	Ti I	2.5	8136.20	Rh I	110	8183.27	Na I
7	8068.46	Sm II	0.9 h	8136.79	V I	0.8	8185.63	Nd
1.2	8068.98	Ta I	1.4	8137.21	U I	0.6 h	8185.90	Gd I
80	8070.08	Zr I	1.8	8138.46	Th I	3.0	8186.71	V I
2.5	8070.70	Ce	0.9 h	8139.92	Th II	2.5	8186.92	Th I
2.0	8074.03	U	0.5	8140.74	Dy II	2.0	8187.33	V I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
2.0	8188.20	U	0.9	8233.55	Dy II	1.6	8300.88	Sm II
1.2	8188.77	Zr I	1.0	8239.48	Ce	0.9 h	8302.74	Nd
0.4 h	8192.60	Mo I	0.6cw	8240.00	Nb I	6 w	8305.79	Sm II
1.0	8193.03	Co I	2.0	8240.37	Zr I	14	8305.90	Zr I
1.2 h	8193.63	Rh I	0.7	8240.51	U I	1.6	8305.91	Hf II
2.0	8194.20	Tm	2.5	8240.98	Sm II	1.8 h	8306.31	Ti I
4	8194.73	Zr I	2.0	8241.13	Sc I	1.2 h	8307.41	Ti I
220	8194.81	Na I	1.6	8241.54	Ce	0.8	8307.56	U
6	8194.82	Tb II	2.0	8241.61	V I	2.0	8307.72	Nd
3.0 w	8195.50	Sm II	0.6	8243.95	Dy II	0.7	8309.50	Zr I
1.4 h	8196.98	Sc I	2.0 h	8245.06	Mo I	1.4	8310.24	Ce I
4	8198.75	Dy II	1.2	8245.20	Ce I	1.6	8310.61	U
2.5	8198.87	V I	0.8	8246.82	Ce	1.2 h	8311.76	Ti I
0.3	8198.95	Fe I	5	8247.44	La I	1.2	8312.37	Ce
0.8	8199.20	Ce	0.8	8248.77	Nd	1.0 h	8312.85	Ti I
15	8201.55	Dy II	0.8	8248.81	Hf I	4	8312.90	Er I
6	8201.73	Zr I	1.0 c	8248.95	Ta I	0.7 h	8315.02	Gd II
3.0	8203.07	V I	1.0 h	8249.70	Nd	1.6	8315.45	Sm I
2.0	8203.21	Th I	1.0	8250.64	Ce II	1.2 h	8316.04	La I
0.7 h	8203.38	La I	0.8	8252.39	Th I	1.0	8316.38	Gd II
16	8204.58	Hf I	2.5 c	8253.51	V I	3.5	8318.34	U
1.4 h	8205.36	Nd	4 h	8254.10	Be I	0.7	8320.16	Zr I
1.0	8206.30	Sm II	2.5	8255.88	V I	2.5	8320.86	Th I
0.5	8208.30	Dy II	0.7	8259.08	Tb I	1.4cw	8320.93	Nb I
0.8	8208.66	Co I	0.6	8261.02	Th I	0.4	8322.00	W I
0.7	8209.07	Gd I	2.0	8261.09	Ce I	0.6	8323.81	Dy I
4 cw	8209.80	Eu I	4	8262.05	U I	0.7	8324.42	V I
0.5	8210.20	W I	0.9 h	8262.80	Nd	1.2	8324.51	Nd
6 h	8210.24	Ba I	0.8	8263.93	Th	8	8324.69	La I
1.4	8210.27	U	1.6 d	8264.85	Ta I	5	8326.04	Dy I
0.6 c	8211.90	Pr	2.0	8264.96	Ru I	3.5	8327.00	Tb I
28	8212.53	Zr I	3.0	8265.50	Dy I	4	8327.06	Fe I
9	8212.57	Tb II	1.4 h	8266.71	Nd	0.8 h	8327.65	Ce
1.0	8214.33	Tb I	1.0	8267.62	Ti	3.5 h	8328.44	Mo I
1.2 h	8216.98	Dy II	0.9	8272.75	Nd	2.0	8328.63	Er II
1.2	8217.23	Th II	50	8273.52	Ag I	0.9	8329.61	Y I
1.6	8218.08	Gd I	1.4	8275.42	Gd I	1.4	8329.73	U
1.6	8218.58	Dy II	3.0	8275.63	Th I	5	8330.47	Th I
4 w	8218.76	Sm II	7	8276.95	Hf I	1.2 h	8331.23	V I
3.0	8220.37	Tb I	0.4 h	8280.39	V I	0.9	8331.94	Fe I
3.0	8220.41	Fe I	6	8281.62	Ta I	0.9	8332.01	Nd
1.4	8220.71	Ce I	1.6	8282.37	V I	1.4	8332.44	Zr I
1.2	8223.62	Ce I	4	8283.81	Zr I	1.6	8334.37	Ti I
1.2	8224.28	Ce	3.0 w	8289.26	Sm II	3.5	8337.46	U
1.0	8224.74	Pt I	0.7	8289.84	Pr	0.9	8338.01	W I
2.5cw	8226.81	Eu I	0.8	8294.53	Tm	0.4	8339.43	Fe I
1.4	8230.33	Sm I	0.7	8299.81	Zr I	1.2	8342.03	V I
1.4	8230.83	U I	0.8 d	8300.58	Ce	3.0	8344.25	Hf I
2.0	8231.47	Nd		8300.72	Ce	2.5	8344.43	Y I
0.3	8232.35	Fe I	5	8300.83	Pd I	1.4	8346.08	Nb I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum
2.5	8346.35	Nd
9	8346.53	La I
2.5	8346.74	U I
0.9	8348.28	Cr I
3.0 w	8348.68	Sm II
0.4	8348.76	W I
1.2	8348.98	Ru I
1.4	8349.73	Gd I
0.5	8350.04	Nb I
0.8	8351.15	Mo I
0.7	8352.94	Ru I
1.8	8353.15	Ti I
1.0 h	8353.58	Pd I
0.9 h	8355.16	Ce
1.4	8357.07	U
0.6	8358.67	W
0.7	8358.72	Th I
10	8364.24	Ti I
0.8 h	8365.64	Y I
1.0	8365.74	Tm
0.6	8367.62	Er II
0.7	8369.34	Th I
0.8 h	8369.55	Rh I
5	8370.23	Zr I
2.0	8372.84	Co I
0.6	8374.76	Gd I
1.6 h	8375.23	Nd
0.6	8377.79	Gd I
13	8377.85	Ti I
0.7	8378.39	Co I
0.7	8379.77	Pr
0.8 h	8379.80	La I
0.6	8380.06	Hf I
4	8381.86	U I
3.0	8382.08	Lu I
13	8382.54	Ti I
7	8382.82	Ti I
0.3	8382.87	W I
0.6	8382.98	Hf I
3.0	8383.71	Sm I
1.0	8387.10	Th II
1.6	8387.16	U
3.0	8387.77	Sm II
4	8387.77	Tb I
3.5	8387.78	Fe I
0.7	8388.48	Dy I
0.9	8389.06	Ta I
2.5	8389.17	U I
4 h	8389.32	Mo I
12	8389.41	Zr I
5	8391.96	Dy II
0.9	8394.72	Nd
1.4	8396.40	Ce
1.6	8396.76	U
10	8396.87	Ti I
1.6	8398.30	Gd I
1.4	8400.79	Nd
0.4	8402.55	W I
0.8	8402.58	U
0.6	8402.81	V I
3.0	8403.79	Th II
0.9 d	8405.24	Ce II
1.8	8405.80	Dy II
6	8410.00	Er I
16	8412.36	Ti I
7	8414.00	Zr I
0.4	8415.73	Ta I
3.0	8416.61	Dy II
2.5	8416.72	Th I
2.5	8416.98	Ti I
5	8417.13	Re I
0.9	8418.00	Th I
2.5	8418.24	Ce
2.0	8421.22	Th II
2.0	8424.41	Ti I
1.4	8425.51	Rh I
22	8426.52	Ti I
0.7 h	8427.79	Pr
5 w	8432.64	Sm II
65	8434.94	Ti I
32	8435.70	Ti I
0.4	8435.77	Ru I
3.5	8438.57	Dy II
5	8438.93	Ti I
0.8	8439.77	Nb I
3.5	8441.20	U I
1.0	8442.58	Gd II
1.4	8444.44	Dy II
8	8445.35	U I
1.4	8445.47	Gd I
1.4	8445.49	Th I
3.5	8446.51	Th I
2.0cw	8447.62	Ta I
4	8450.03	U I
3.5	8450.06	Tb II
0.6	8450.26	Cr I
1.8	8450.36	Y I
0.9	8450.67	Th II
5	8450.89	Ti I
5	8453.17	Zr I
0.8 b	8453.55	La LaO
0.3	8455.24	Cr I
1.0 h	8456.80	Nd
1.2 h	8457.10	Ti I
0.6	8457.48	Zr I
6	8459.19	Lu II
4	8460.01	Hf I
1.0	8460.77	Tm
5	8464.65	Zr I
1.0 h	8464.66	Ho I
1.0 h	8464.71	Eu I
0.7 h	8465.80	Tb II
1.2	8466.11	Er II
2.5 h	8467.15	Ti I
0.8 h	8467.62	La I
1.2	8468.41	Fe I
6	8468.50	Ti I
1.4	8468.59	Tb I
4	8472.02	Tm
4	8472.39	Er I
0.7	8472.48	Dy II
3.0 w	8473.54	Sm II
1.2	8473.64	Ru I
0.4	8475.16	W I
0.8cw	8475.98	Nb I
2.5	8476.48	La I
3.0	8478.37	Th I
1.8 d	8478.50	Lu I
0.6	8480.50	Dy II
1.0 h	8482.67	Ho I
4 h	8483.39	Mo I
1.2	8483.56	Ru I
7 w	8485.99	Sm II
0.7	8490.17	Dy I
1.8	8495.82	Ce II
0.9	8495.98	Zr I
2.0	8496.04	Ti I
1.6	8496.09	U I
12	8498.02	Ca II
4	8498.44	Zr I
1.0	8499.52	V I
0.9	8500.67	Th I
1.2	8502.70	Tb II
1.6	8504.70	U II
1.2 h	8507.37	La I
5 c	8508.08	Lu I
1.4	8510.77	Dy II
5 w	8510.90	Sm II
0.9 h	8511.34	Ce II
3.0 h	8512.01	Tb

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum	Intensity and Character	Wavelength in A	Element and Spectrum
5	8512.94	Ho	0.8	8561.72	Gd I	0.7 h	8624.22	La I
1.2 h	8513.57	La I	1.4 b	8563.54	La LaO	0.5bl	8624.86	V VO
0.5	8513.78	Zr I	1.4 h	8564.58	Ce I	1.6	8629.95	Dy I
0.9	8514.08	Fe I	1.6	8565.73	Tm	3.5 w	8632.82	Sm II
0.8 h	8514.65	La II	1.2 h	8567.48	Ce I	1.4	8635.6	Dy II
0.5	8515.06	Zr I	1.6	8567.73	U I	1.4	8638.47	La I
0.3	8515.11	Fe I	1.0	8567.93	Dy II	0.6	8639.44	Th I
1.0 h	8516.55	Th I	0.7	8568.22	Th II	20	8640.06	Hf I
1.6	8517.66	Er II	0.8	8568.54	Zr I	0.5	8641.01	Zr I
0.6	8517.68	Dy II	1.2	8569.77	Ti I	2.0	8641.12	U
2.5 h	8518.05	Ti I	3.5	8570.51	U I	3.5cw	8642.67	Eu I
5	8518.32	Ti I	0.7	8571.05	Zr I	1.6 c	8643.48	Nd II
1500	8521.10	Cs I	1.8	8573.14	Th I	0.6	8645.31	Th I
2.0	8521.35	Er II	0.4 h	8574.57	Co I	1.6 h	8647.66	Ce I
1.4 h	8523.34	Ce I	1.6	8574.61	U I	4	8655.90	Dy II
1.0	8525.73	Dy II	1.0	8575.35	Co I	2.5	8657.71	Dy II
1.6 b	8526.59	La LaO	1.2	8575.54	Dy II	1.6	8659.52	U
1.2	8526.99	Nb I	0.8	8575.87	Nb I	0.8 h	8659.66	Gd II
3.5cw	8527.73	Re I	1.2	8575.92	Ta I	0.4	8661.09	Co I
1.8 h	8527.88	Gd I	0.6 h	8579.77	Gd II	1.2 h	8661.48	Gd I
0.6 h	8528.28	Dy II	1.0	8582.03	Nd	3.5	8661.91	Fe I
0.8 h	8528.94	Y I	4	8583.45	Tb II	3.5	8661.91	Tb I
0.9	8530.44	Nd	1.8	8584.21	Zr I	55	8662.14	Ca II
2.0 h	8532.74	Pd I	2.5	8585.06	W I	1.6	8665.50	Th I
0.5	8534.49	V I	0.3	8586.74	Co I	1.0	8667.00	Nd
2.0	8539.08	Ce II	0.8 h	8587.64	Th II	1.0 h	8667.32	Dy II
1.8	8539.38	Ti I	0.7	8587.84	Zr I	0.7	8668.11	Th I
2.5	8540.20	U I	0.8	8589.73	Co I	3.0	8668.63	Gd I
100	8542.09	Ca II	0.9 h	8590.94	La I	4	8670.19	Ho
0.8	8542.32	U	1.0	8591.43	Nd	0.8 h	8670.92	Mn I
3.5	8543.22	Sm II	2.0	8591.85	Th II	1.0 h	8672.06	Mn I
1.6 c	8543.46	La I	0.9	8594.37	W I	1.8hw	8672.11	La I
0.7	8543.69	Th I	1.4	8594.84	Nd	1.0	8672.51	Dy I
0.6	8544.58	Th I	0.8cw	8595.84	Ta I	0.8 h	8673.97	Mn I
6	8545.44	La I	1.2 h	8598.18	Ti I	4	8674.43	La I
2.0	8545.61	Ho II	1.8 h	8599.10	Pd I	0.9	8674.75	Fe I
1.0 h	8546.09	Tm	0.9 b	8600.81	La LaO	0.7	8674.86	Gd I
18	8546.48	Hf I	1.8	8601.84	Ho II	12	8675.39	Ti I
0.6 c	8547.25	Nb I	3.0	8603.40	Tb I	1.0	8677.48	Nd
5	8548.12	Ti I	0.7 h	8605.20	Pr	1.8 w	8677.93	Sm II
0.6	8548.86	Cr I	17	8607.94	U I	0.8	8678.25	Tb I
1.2	8548.96	Dy II	0.5	8610.24	Zr I	2.5	8678.37	Dy II
0.9 h	8550.49	Ta I	6 c	8610.98	Lu I	6	8682.99	Ti I
0.8 h	8552.60	Sn I	0.6	8611.81	Fe I	0.8	8685.1	Dy I
0.6 h	8556.32	Th I	1.6	8612.65	Ce I	0.7	8686.12	Th II
1.6	8557.34	U I	0.7	8613.26	W I	4	8688.61	Tb I
1.4	8557.74	Dy II	0.3	8614.48	W I	7	8688.63	Fe I
0.7	8559.11	Gd I	0.6	8615.97	Gd II	5	8691.28	U
40 h	8559.95	Ba I	3.5 w	8617.03	Sm II	1.2	8691.30	Nd
0.8 c	8560.54	Nb I	0.8	8618.96	U	3.0	8692.33	Ti I

Table 2. All Observed Lines in Order of Wavelength

Intensity and Character	Wavelength in A	Element and Spectrum
1.2	8695.07	Nd
1.6	8696.90	Dy II
0.8 h	8697.32	Ho
1.0 c	8697.55	Nb I
1.0 h	8701.05	Mn I
1.0	8702.08	U
1.8 h	8702.38	Ce II
1.4 h	8703.76	Mn I
2.0	8706.32	Sm II
7 w	8708.43	Sm II
0.9	8709.24	Th I
4	8710.77	U I
2.5	8710.84	Ru I
5	8711.24	Hf I
1.2	8712.84	Nd
1.2	8714.43	Pr
1.2	8715.01	Nd
1.6 h	8715.88	Dy II
1.2	8716.66	Ce II
5 w	8717.89	Sm II
0.8	8719.63	Th I
1.2 h	8720.41	La I
0.8	8721.67	Th I
1.6	8724.98	Ru I
1.2	8727.77	Eu I
1.4	8732.42	Th II
2.5	8734.69	Ti I
1.0	8734.86	Zr I
2.5 h	8740.93	Mn I
1.0	8740.96	Nb I
3.0	8748.03	Th I
3.5	8748.38	La I
1.0	8749.16	Th I
1.2	8749.48	Zr I
3.0	8750.30	Dy II
0.9	8752.77	Gd I
4	8753.69	U I
0.8	8757.19	Fe I
7	8757.75	U
2.5	8758.24	Th I
5 w	8758.28	Sm II
7	8761.35	Pd I
55	8761.38	Cs I
2.5 h	8761.40	Sc I
0.6	8762.93	Zr I
0.8	8764.00	Fe I
6	8765.74	Tb II
3.0	8766.64	Ti I
1.0	8767.97	Nb I
2.5	8768.58	Er I
1.6	8770.36	Gd I
4	8772.14	Ce II
1.4 h	8774.8	Sc
1.4 h	8775.58	Th I
1.2 h	8776.59	Er I
1.0	8777.36	Ru I
2.0 h	8778.71	Ti I
2.5 w	8780.59	Sm
1.8	8780.74	Dy I
1.4	8782.17	Ce
1.0	8782.46	Eu I
1.4 h	8784.57	Th II
1.8	8784.85	Gd I
1.0	8786.23	Zr I
1.8	8787.37	U
3.5 w	8788.83	Sm II
0.6	8789.87	Ge I
2.0cw	8790.88	Eu I
7	8791.37	Dy II
0.6	8793.38	Fe I
2.0 h	8794.72	Sc I
1.4	8795.76	Gd I
10	8800.62	Y I
1.6	8804.98	Zr I
1.6 h	8805.48	Ho II
14	8806.79	Mg I
0.3	8809.42	Ni I
2.0	8810.86	Ce I
1.4cw	8815.56	Nb I
1.4	8816.16	Th II
2.0	8816.56	U
1.8	8818.93	La I
0.7	8819.15	Co I
2.0 h	8823.8	Sc
4	8824.23	Fe I
3.5	8825.82	La I
3.0 h	8832.06	Gd II
1.0	8832.67	Dy II
2.0	8832.92	Dy II
4 h	8834.45	Sc I
2.0 c	8834.49	Ho I
2.0 h	8835.85	Y II
7	8836.09	Zr I
3.5	8838.96	Nd
2.0	8839.63	La I
1.0	8841.16	Th I
3.0	8842.08	Th II
2.0 h	8849.14	Gd I
3.5	8850.21	Dy II
4	8859.76	Sm
3.0	8860.98	Ba I
1.4	8862.55	Ni I
1.2	8865.50	W I
1.0	8866.89	Er
1.0	8866.96	Fe I
2.5 h	8867.31	Gd I
2.5	8868.81	Th I
3.0	8870.30	Eu I
5	8891.20	Ce I
6	8899.52	Zr I
7	8905.62	Dy II
1.6	8905.78	Nb I
15	8913.66	Sm II
3.5	8914.99	Ba I
9	8915.98	Ho II
5	8918.80	Se I
5 c	8919.85	V I
7 h	8922.62	Yb II
2.5 c	8932.93	V I
800	8943.50	Cs I
4	8947.15	Cr I
2.5	8957.97	Th II
7	8967.61	Th I
1.0	8971.62	V I
2.5bl	8971.96	Th ThO
2.0	8976.83	Cr I
2.5	8999.56	Fe I
8	9004.73	Hf I

Selected Publications of the National Bureau of Standards

Table of Wavenumbers, C. D. Coleman, W. R. Bozman, and W. F. Meggers:

Monograph 3, Volume I. 2000 A to 7000 A. 508 p. (1960) $6.00

Monograph 3, Volume II. 7000 A to 1000 μ. 542 p. (1960) $6.00

New Description of Thorium Spectra, Romuald Zalubas, Monograph 17, 106 p. (1960) $0.65

Atomic Energy Levels, C. E. Moore:

Circular 467, Volume I. H to V (Z=1 to 23) 206 spectra. 309 p. (1949) $5.50

Circular 467, Volume II. Cr to Nb (Z=24 to 41) 152 spectra. 227 p. (1952) $4.00

Circular 467, Volume III. { Mo to La (Z=42 to 57) / Hf to Ac (Z=72 to 89) } 124 spectra. 245 p. (1958) $2.50

An Ultraviolet Multiplet Table, C. E. Moore:

Circular 488, Section 1. H to V (Z=1 to 23); Selected Multiplets of 79 Spectra. 78 p. (1950). $0.55

Circular 488, Section 2. Cr to Nb (Z=24 to 41); Selected Multiplets of 46 Spectra. 115 p. (1952). $0.70

The above publications may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

A Multiplet Table of Astrophysical Interest, C. E. Moore. A Reprinting of the 1945 Multiplet Table (Princeton Univ., Obs. Contr. No. 20):

Technical Note 36 (PB151395), Part I. Table of Multiplets and Part II. Finding List, λλ2951Å–13164Å. 242 p. (1959). $4.00

The above Technical Note may be purchased by the PB number from the Department of Commerce, Office of Technical Services, Washington 25, D.C.

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